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To describe and compare the psychosensory functioning of normal children and children with specific learning disabilities, 62 learning disabled and 68 normal children were studied. Each child was given a battery of thirteen subtests on an automated psychosensory system representing various combinations of auditory and visual intra- and intersensory conditions for verbal, nonverbal-nonsocial, and nonverbal-social stimuli. Comparisons were made between the normal children and the two types of learning disability groups (a school learning disability group and a clinic learning disability group). Two age groups of children were considered: 8-year-olds and 9-year-olds. The clinic learning disabilities appeared to have more acute disorders as a group than the school-derived population of learning disabilities. They made significantly more errors on verbal psychosensory functions, regardless of the sensory conditions. In addition, the 9-year-old group displayed significant problems of an auditory intrasensory nature. There was a generalized failure of the clinic learning disabilities to perform the tasks with speed equivalent to their comparison groups. The use of response time criteria seemed encouraging as an area for future investigation but test batteries need revision as items may have been too easy. (Author/RP)

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Final Report

Project No. 6-2549
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Visual and Auditory Learning Processes in Normal Children and Children with Specific Learning Disabilities

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Evanston, Illinois

September 1967

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D.A.O.

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SUMMARY

Of special interest among those concerned with learning disabilities has been the perceptual functioning of children manifesting such disorders. Much emphasis has been placed on visual perception and auditory perception, especially the former. It has become evident, however, that assessment of intrasensory functioning alone is insufficient to understand the nature of most learning disabilities. It has been suggested that knowledge of intersensory perception would be of considerable value in attempting to comprehend the nature of learning disabilities.

Although some specific intrasensory tasks have been devised for use in psychoeducational evaluations, most conclusions about the psychosensory integrities of individuals have been based on suppositions from the results of psychometric tests that were not designed specifically for the purpose of assessing inter- and intrasensory functions in children. This battery of tests was designed to evaluate psychosensory integrities of the auditory and visual sensory channels and their intersensory combinations. Thus, the psychosensory conditions were: auditory-auditory; visual-visual; auditory-visual; and visual-auditory. Verbal stimuli and nonverbal stimuli were used. The latter included stimuli of both social and nonsocial nature for each sensory channel.

Instrumentation was such that these stimuli could be presented in an automated fashion, with the additional capability of automatic measurement and recording of errors and response times. This was accomplished by means of the Psychosensory Communications System, designed and constructed at the Institute for Language Disorders, Northwestern University.

The study was intended to describe and compare the psychosensory functioning of normal children and children with specific learning disability. In addition, it was possible to contrast the results of this type of assessment with traditional psychoeducational evaluation. It was expected that these data would clarify the classification of children with learning disability and contribute to the knowledge of intra- and intersensory processes.

Children with learning disabilities and normal children were studied. Some of the learning disability children were selected by means of a screening and intensive psychoeducational diagnostic process from the public schools. Others were children referred to a special clinic for diagnosis of learning disabilities. Each of these children was given a battery of thirteen subtests on the

automated psychosensory system. The thirteen subtests represented various combinations of auditory and visual intra- and intersensory conditions for verbal, nonverbal-nonsocial, and nonverbal-social stimuli. Comparisons were made between the normal children and the two types of learning disabilities groups (the School Learning Disability group and the Clinic Learning Disability group). Two age groups of children were considered: eight-year-olds and nine-year-olds. Errors and response times were the primary measures utilized in the analysis.

School Learning Disabilities. (1) Eight-year olds. A summary of the psychosensory test findings for the School Learning Disabilities indicates the following. The group of children designated as having learning disability through school screening and intensive psychoeducational testing had no difficulty in performing psychosensory tasks of any type at the eight year level. Their proficiency, according to error scores, was equivalent to that of children without learning disability. Not only did they perform well, but their response times tended to be faster, sometimes significantly so.

Thus, the psychosensory test battery cannot be considered as a sensitive tool for discriminating learning disability among such a population of eight-year-old children. On the basis of this battery no psychosensory disabilities were determined. If in fact specific auditory and visual intra- or intersensory deficits existed, the testing did not reveal them.

These eight-year-old children did, however, have learning disabilities, as indicated in the results of the psychoeducational testing. Their reading and spelling ability in particular was below expectation for their mental ability, age, and grade placement. In addition, scattered subtests of learning aptitude and mental ability were significantly poorer than a group of normal children.

For the eight-year-old group of children with School Learning Disabilities the psychoeducational procedures appeared to be more valuable than our measurements of psychosensory functions. If given a choice, it would appear that standard psychoeducational measures would, at this time, be preferable to the psychosensory measurements utilized in this study.

(2) Nine-year-olds. Nine-year-old children with school-determined learning disabilities did poorly on several of the psychosensory tests. They made significantly more errors than their control group for psychosensory functions in which verbal symbols were used. All psychosensory conditions,

whether intrasensory or intersensory, demonstrated this trend. Despite this, the learning disordered children performed faster, according to response time analysis. This was consistent with the results of the eight-year-old School Learning Disability group.

Again, however, the psychoeducational battery indicated problems of greater severity than were uncovered by the psychosensory battery. This group of nine-year-old learning disorders was lower than the comparison group for the following functions: reading, spelling, arithmetic, oral language, written language, mental ability, auditory verbal memory, visual nonverbal memory and social maturity. As with the eight-year-olds, the psychoeducational battery was superior to the automated test battery. The only functions which the psychosensory battery detected as being poor were equivalent to functions which were noted through the psychoeducational testing.

Clinical Learning Disabilities. The Clinic Learning Disability population, that is, those classified as having problems after being referred to a special clinic for children with specific learning disability, appeared to be a different population from the School Learning Disability group. Because they were seen for classification at varying ages, no direct psychoeducational comparisons were made. However, they had more acute disorders as a group than the school-derived population of learning disabilities. The mere fact that they were referred to a clinic and the others were not represents face validity attesting to that fact.

On the psychosensory evaluation both the eight-year-old and the nine-year-old Clinic Learning Disabilities groups made significantly more errors on the verbal psychosensory functions, regardless of the sensory conditions. In addition, the nine-year-old group displayed problems of an auditory intrasensory nature. It might be concluded from out data that the verbal or symbolic quality of stimuli was more important than the sensory avenue(s) through which they were communicated.

A finding of great significance, however, was the generalized failure of the Clinic Learning Disability groups to perform the tasks with speed that was equivalent to normal children. In nearly all instances the response time of the normal children was faster, and in several instances significantly so. The nine-year-old group seemed to show the slowest responses for those items which used verbal stimuli. The use of response time criteria, a feature unique to the Psychosensory Communications System, seemed encouraging as an area for future investigation. It is suggested that further utilization of response time measures for psychosensory evaluations would be useful.

INTRODUCTION

Eudcation is today faced with increasingly complex challenges in its attempts to prepare youngsters to meet the demands of present day society. In addition, the tremendous numbers of children, who becasue of specific reading, writing, and spelling disabilities, do not acutalize their potential in learning situations, are of major concern to all involved in the instruction of children.

It has been estimated that the incidence of reading difficulties is as high as 30 percent of the school population (21). The failure to master the skills of reading at a functional level has potential impact to the child's social, emotional, intellectual, and vocational potential.

Of primary concern is the youngster who with normal or above intellectual ability fails to achieve his potential in academic situations. Learning may be impeded by a number of conditions. For example, loss of sensory acuity (as in deafness and blindness), emotional disturbances, or cultural deprivation. When none of these conditions is identifiable and a child fails to achieve academically, it might be assumed that there is a dysfunction in the central nervous system. The term "psychoneurological learning disorder" has been used to designate this type of disorder (14). In the past, learning problems associated with brain dysfunction were considered only when children manifested gross neurological involvements (e.g. cerebral palsy) or mental retardation. Today, however, children can be viewed operationally as having a dysfunction of the brain even though gross neurological signs are absent. These children have constitutional integrity and competence in general, but they cannot profit normally from experience; they have a deficiency in learning, but not an incapacity to learn. It has been estimated that five to ten percent of the total school population have learning problems which are psychoneurological in nature (16).

Although specific learning problems have been described which affect non-verbal abilities, listening ability, writing, spelling, and arithmetic (8), the most promenient of these disorders involves the inability to read. The term "dyslexia" is sometimes used to designate the problem when reading is affected by minimal brain dysfunction (9,17). The diagnosticians of children with these learning disabilities have placed a heavy emphasis on "perception". The assumption has been that perceptual disorders are indicative of minimal neurological dysfunction (or minimal brain damage). Thus, failure at perceptual tasks has been used as a criterion for assuming the presence of an organic disorder. Consequently, it has become common clinical practive to make judgments regarding the ability of children to process sensory information. Such judgments have been made primarily on performances on a few standardized psychological.tests (23,24).

Perceptual disorders are typically categorized according to the sensory channel that has been affected. Thus, a child may be described as having a visual, auditory, or tactual perceptual problem. Our clinical diagnostic studies of children with reading disabilities have revealed many who have problems with specific auditory or visual learning processes. These might be termed psychosensory learning disorders. Hinsie and Campbell (7) have defined psychosensory as the "mental perception and interpretation of sensory stimuli". Thereby, those who have psychosensory learning disorders cannot normally perceive and interpret sensation received through a particular sense channel. Similarly, they might not be able to relate sensory experience received through a given sense modality to experience gained through learning to "auditorize" from what they see or "visualize" from what they hear.

Considerable research has been devoted to aspects of perception within a given sensory modality, i.e. intrasensory perception (5,11, 22,19,20). Other studies have investigated the relationships between sensory modalities at the perceptual level, i.e. intersensory perception (1,2,3,4,10,12). Theoretical consideration has arisen from the principle that "as one ascends in the vertebrate series from fish to man the unimodal sensory control of behavior comes to be superseded by multimodal and intersensory control mechanisms" (3 p3). Thus, the total system for processing sensory input in Man must be considered as a series of semi-autonomous systems. As input of information occurs in the organism it is processed by individual channels in an autonomous, sensory-specific manner. Penfield's work in neurology (18) corroborates this, as does Guilford's recent factor analysis of the structure of intellect (6). According to Guilford, cognition, or perception, and memory consist of distinct sub-factors representing the various sensory channels. At further stages of thinking the processes of synesthesia, intersensory perception and integration serve to coordinate sensory information.

Reading is a process which requires integration of auditory and visual information. The letters of the English language are phonic in nature; they represent sounds. Also the written word (visual) is a symbolic representation of the spoken word (auditory). Adequate processing of auditory and visual information would seem to be basic prerequisities to reading. Consequently the study of intra- and intersensory functioning for the auditory and visual channels would appear to be of significant value among children with reading disorders. Such an investigation should have implications for remediation as well as classification. For example, some programs for children with learning disabilities assume that the child's disturbed perception may be improved by associating the experiences of the aberrant modality with information processed normally through an intact sensory avenue. For example, visual perception may be improved by having the child"touch" or "feel" various configurations of figures or letters. Such procedures assume, of course, that intersensory transducing of information is operating efficiently and effectively.

A similar analysis can be made of other academic areas and other areas important to learning. Although there is considerable literature reporting intrasensory perception, research on intersensory perception among children with learning disabilities has been limited. Although some relevant developmental studies have been done, little has been done to establish the parameters, or dimensions of intersensory perception in children. In the differential diagnosis of learning disabilities in children, clinicians have utilized psychometric tests, educational achievement tests, and other special abilities measures and attempted to make appropriate interpretations regarding a child's intra- and intersensory processes or his ability to transduce information from one sensory modality to another (13). The disadvantage of this technique, however, is that psychometric tests are not designed specifically to "test the systems".

It appears, then ,that an improved method for the appraisal of intra- and intersensory perception would be useful in the evaluation and planning of remediation for children with specific learning disabilities. A Psychosensory Communications Unit has been developed at the Institute for Language Disorders, Northwestern University, for this purpose. The apparatus is designed to assess psychosensory abilities and may be used also to teach such skills when they are found to be deficient.

The purpose of the investigation was to delineate intra- and intersensory functions in normal children and children with specific learning disabilities. The overall objective was to provide a useful classification system for determining appropriate remedial education among children with learning disabilities. In addition, the study assessed the validity of two methods for measuring psychosensory processes: psychoeducational tests and specifically designed automated tests.

Specifically, the study attempted to provide:

(1) comparison of normal and learning disability children in inter- and intrasensory functions of basic importance to learning;

(2) norms for automated measurement of these functions;

(3) a comparison of psychosensory functions with

psychoeducational, neurologic, electroencephalographic, pediatric, and ophthalmologic information obtained from a companion study;

(4) definitions of the parameters of intra- and intersensory functions among normal and learning disability children;

(5) a system for the classification of certain reading disabilities and other learning disabilities

Although children with reading disorders and other learning disabilities have presented a continuing challenge to educators, little has been done to investigate the relationships between the learning of academic skills and the processing of sensory information in the brain. This investigation purported to investigate these relationships as they relate to actual academic progress.

METHOD

The essential procedure was to administer an automated test battery which measured a variety of intra- and intersensory learning functions to two groups of children designated as a Control group and a Learning Disability group. The Learning Disability group consisted of 24 eight-year-old and 38 nine-year-old children with learning disabilities. A carefully selected group of Control subjects was compared with the Learning Disability group on the basis of age, grade, sex, teacher influence, and socio-economic factors. There were 19 eight-year-old and 49 nine-year-old children included in the Control population. A total of 130 children (Table 1) were studied.

TABLE 1

NUMBER OF CHILDREN INCLUDED IN THE STUDY

Learning Disability Eight-Year-Olds	24	Control Eight-Year-Olds	19
Learning Disability Nine-Year-Olds	38	Control Nine-Year-Olds	49
Total Learning Disability	62	Total Control	68

Total Number in Study. . 130

The Sample

Subjects were selected from two primary sources. The main group of subjects was obtained from a larger group of eight and nine-year-old children who were participating in a Northwestern University- U.S. Public Health Services Learning Disability Study. All of the Control subjects were randomly selected from among the normal children in this group. In addition, a group of children with learning disabilities was randomly selected from a larger group of such children who had been so designated in the U.S. Public Health Study. For the purpose of this study they are designated as the School Learning Disability group. A second group of children with Learning Disabilities was selected from a clinical population. They were eight and nine-year-old children seen on referral to the Institute for Language Disorders because of learning difficulties. For the purposes of this study, they are designated as the Clinic Learning Disability group.

The group of youngsters selected from the Northwestern University-U.S. Public Health Services study afforded the investigators unique opportunities for study. The Learning Disability Study is presently completing its second year. In the first year 529 third and fourth grade children were screened in the Northbrook, Illinois public schools and in the second year 869 third and fourth grade children were screened in the Skokie and Glencoe, Illinois public schools. A three-hour battery of tests, including group measures of intelligence, together with educational achievement in reading, arithmetic, and spelling, was utilized. A second phase of the investigation consisted of studying intensively those youngsters revealed in the screening as underachieving in academic subjects and suspected of having specific learning disabilities. In the second phase of the study 76 youngsters from the Northbrook group, 71 youngsters from the Skokie group, and 68 youngsters from the Glencoe group suspected of learning disabilities on the basis of the screening, together with a matched control group of like number were seen. This portion of the study consisted of an intensive five-hour behavioral assessment of each child through individually administered psychometric and educational achievement tests. In addition, a standardized neurological examination, an electroencephalographic study, and an ophthalmologic examination were obtained.

Therefore, a careful, intensive, and detailed analysis of each child was accomplished before they were seen for appraisal on the automated psychosensory unit. Accurate designation of controls and learning disability youngsters was determined at virtually no expense to this project. All children were selected from school settings where cultural and racial differences were minimized. Therefore,we were able to concentrate on the learning processes involved without undue influence of other significant variables. The School Learning Disability group consisted of 10 eight-year-olds and 21 nine-year-olds. There were 19 eight-year-olds and 49 nine-year-old Control subjects included in the study.

The clinic referred group of eight- and nine-year-old youngsters also underwent psycho-educational study. Neurological, electroencephalographic, and ophthalonologic information was also available. A total of 14 eight-year-olds and 17 nine-year-olds comprised the Clinic Learning Disability group. The combined total of School Learning Diability children is reflected in the Learning Disability group figures in Table 1.

Learning Disability Group. Youngsters were classified as having learning disabilities according to the following criteria:

(1) Average, or better intelligence. The criterion was set at 90 IQ or better, according to either the Verbal or the Performance Scale of the Wechsler Intelligence Scale for Children. Children with specific learning disorders tend to show significant discrepancies between the Verbal and Performance Scales of the Wechsler test. For example, children with language disorders often have lower Verbal IQs and children with perceptual disorders tend to have lower Performance IQs. The higher IQ in such instances is accepted as indication of the child's learning potential. The lower IQ is a reflection of his disability. If the combined full scale IQ is used it is spuriated by inclusion of the lowered scale, whether verbal or performance. Therefore, we utilized the higher IQ as an index of the child's learning potential.

It should be noted that only three of the 130 subjects in the study had Full Scale IQs below 90. They were each Clinical Learning Disabilities subjects with Full Scale IQs of 88, 88, and 86. Each had higher Performance IQ when compared to Verbal IQ, by differences of 20, 13, and 13 respectively. Their respective Performance IQs were 104, 99, and 94. It can be said, however, that all subjects in the study had normal, or above, intellectual potential.

(2) Difficulty in an academic area: reading, writing, or arithmetic. This criterion was derived by making a comparison between the child's expected level of performance and his actual performance. The former was estimated on the basis of his chronological age, grade placement, and mental age. The actual performance for each academic area (e.g. reading) was based on educational achievement test results. A ration was computed with actual achievement as the numerator and expected achievement as the denominator. The resultant index has been termed the "Learning Quotient", or LQ. The Learning Quotient concept and calculation has been discussed in detail by Myklebust (15,pp 4-9). A Learning Quotient of 89 or less was considered indicative of learning difficulty. For the age range of children in this study, this cut-off corresponds roughly with a criterion of more than one year discrepancy between achievement and expectancy.

It was possible for a child to qualify as a learning disability in one or more of five areas of learning, as defined in the Learning Disability Project: 1. comprehension and/or expression; 2. reading; 3. arithmetic; 4. written language and/or spelling; or 5. non-verbal perceptual or perceptual motor skills. Psychoeducational instruments utilized to assess these functions are listed in Appendix Table II. No attempt was made to subdivide the learning disability children into subgroups, according to specific area(s) of disability, since each subgroup would consist of numbers too small for meaningful analysis. In order to indicate that the learning disability children had problems largely restricted to specific areas, not generalized learning deficits, it should be noted that 90% of both the school and clinic learning disability children were deficient in only one or two of the areas discussed above.

(3) In the initial planning of this study, evidence of neurologic abnormality, determined through neurologic, electroencephalographic, pediatric, and behavioral information obtained from the Learning Disabilities Study was a criterion. However, a portion of that study demonstrated that neurologic, electroencephalographic, and pediatric history data alone were not reliable in making meaningful distinctions. (These results are to be published in conjunction with the completiion of that study.) Because of the test-retest and interexaminer unreliability, it was decided to eliminate these medical data criteria from our definition of learning disability. Therefore, the children in this study were defined as Learning Disability or Control solely on the basis of psychoeducational criteria, as above.

(4) Lack of additional factors contributing to learning disability. Sensory acuity for vision and hearing, anxiety during testing, and general motor ability were assessed. Each was required to be within normal limits, according to the following criteria:

a. Vision (corrected if necessary) better than 20/40 in either eye;
B. Hearing better than 35dB (ISO) in the range of 500-4000 Hz in both ears;
c. Anxiety rating of the Children's Personality Questionnaire (CPQ) within the specified limits of normal (less than 40 points);
d. Motor behavior not observably impaired by such conditions as paralysis or cerebral palsy.

Control Group. The children designated as Controls demonstrated no learning disorders, according to the Learning Disability Study. They met the criterion of 90 IQ or better and had no sensory deficits (vision or hearing), emotional disturbances or significant motor impairment. All children in the Control group had been studied intensively in the Learning Disability Study so that precisely the same complex of behavioral, medical, and educational information was available for both the Control and School Learning Disability subjects.

The procedures for selecting the Control subjects insured that they would be comparable to the School Learning Disability subjects in most relevant aspects, except learning achievement. After the identification of each School Learning Dsiability subject a non-learning disability child of the same age (within three months) was chosen from the same classroom. In the few cases where this was not possible, a random selection was made from a pool of normal children of that age. In this way, it was felt that the Control and School Learning Dsiability groups would be comparable, not only in age and grade placement, but also in other unmeasured elements, such as teacher influence, socioeconomic, and cultural factors.

The Clinic Learning Disability subjects were selected on the basis of age as they were processed through the diagnostic services of the Institute for Language Disorders. They were comparable in age, as indicated on page 18 . The selection processes used at the Institute for Language Disorders would seem to indicate that they were also of approximately the same socioeconomic and cultural backgrounds.

The Procedures

As previously indicated, each subject was administered the automated battery of tests specifically designed to assess certain intra- and intersensory capabilities. The thirty-five to forty minute battery of tests was developed at the Institute for Language Disorders.

Psychosensory Communications Unit. This instrumentation was designed, constructed, and calibrated with the assistance of biomedical engineers over a period of four to five years at a total cost of more than $75,000.00. This cost has been borne primarily by Northwestern University, with additional support from private foundations. The equipment consists of two major elements: A Subject Console and an Examiner's Console.

The subject is seated comfortably at the Subject Console. He faces a vertical panel which is approximately 25 inches in front of him. Presentations of visual stimuli occur through four 3 x 4 windows on the panel. Three of the windows form a row at the bottom of the panel, while the fourth one is centered immediately above that row. Each of the three lower windows has a numbered choice button below it. Thus, the upper window may serve for visual presentation of an initial stimulus and the three lower ones may serve for presentation of comparison stimuli. In this fashion, a word, picture, or figure may appear in the upper window followed by presentation of various visual stimuli in the lower three windows. The subject is asked to indicate which of the three comparison stimuli matches the initial stimulus seen in the upper window. He then pushes the button beneath the picture of his choice.

A modification of this may be employed through the use of two additional buttons which are before the subject. These buttons, labled YES and NO are placed on the horizontal surface of the console. In this instance a visual stimulus may appear in the upper window, together with another visual stimulus in one of the lower windows. The subject merely indicates whether they are "the same" by pushing the YES button or"not the same" by pushing the NO button. Thus, the subject may respond to a "YES-NO" discrimination or to a two-or-three choice task with ease.

Auditory stimuli may be presented through high-fidelity loudspeakers placed at prescribed distance from each ear, or they may be presented through a set of high quality headphones, as was the case for this study. When auditory stimuli are utilized the subject is asked to use the three choice buttons and the YES-NO buttons in the same fashion as that noted for visual presentations. A valuable characteristic of this instrumentation is that combinations of visual and auditory presentations are easily manipulated. For example, the subject may hear a word spoken through the loudspeaker and subsequently see a printed word in one of the visual presentation windows. His response would be to press the YES or the NO button, depending upon whether the auditory and visual words were the same or not the same. Similarly a word could be presented auditorily together with three choices presented visually on the console. In such a manner the subject could push the button under the printed word which "matched" the spoken word.

The variety of material which can be presented visually on the subject console is infinite. A description of the types of presentations to be utilized is given below in the discussion of tests. The variety of possibilities, however, is a real advantage of this instrumentation. Another useful aspect is that environmental light and sound can be carefully controlled during testing. The room has been completely "blacked out" and general room lighting is controlled by rheostat. Thus, not only is light controlled, but it can be varied experimentally. Ambient noise levels have been reduced to a minimum through special sound treatment procedures.

The Examiner's Console serves as the control for automated presentation of stimuli and recording of the subject's responses. It is situated behind the subject and in another section of the room, separated by a glass partition. This allows for the operator (Examiner) to have constant surveillance of the subject's behavior throughout the examination without undue distraction to the subject.

Visual stimuli are stored in a rack in the Subject Console. Auditory stimuli for each test are recorded on a Gates cartridge holder and stored in the Examiner's Console. Both types of stimuli are preprogrammed and controlled from the Examiner's Console by means of a special pat hboard. There is considerable flexibility in this system, allowing for multiple combinations of quditory and visual presentations.

The examiner chooses the mode by which the tasks are to be presented from four possibilities:

(1) Automatic Mode - the unit cycles into the next item every eight seconds from the time the timer is started. If the subject does not respond within the time limit, an incorrect response is recorded automatically.

(2) Manual Mode - the operator controls presentation of the items; he presents the next task by pressing the Advance Button.

(3) Subject Mode - the unit delivers the next item as soon as the subject has given a response; after the response the ensuing item follows automatically. This was the mode utilized throughout the study.

(4) Teach Mode - the unit delivers the next item only after the *correct* response has been given; the unit operates as a teaching machine because the subject is automatically rewarded with the new task as soon as he gives the correct response.

The subject's responses are automatically recorded as "correct" or "incorrect" so that ordinary error counts may be made for all testing. A unique aspect of this instrumentation, however, is that the time of response is also accurately recorded. Times were recorded to the nearest tenth of a second. By analysing the "latency" of responses, the length of time from presentation of stimuli until the subject presses the response button, we are able to determine information not heretofore possible.

Another key characteristic of this instrumentation is that the presentation of stimuli may be completely standardized and controlled from subject to subject. Thus, through the Psychosensory Communications Unit a comprehensive analysis of intra- and intersensory functions is possible.

Psychosensory Tests. Each of the psychosensory test items is presented to the subjects through the Psychosensory Communications Unit. A diversified battery consisting of 13 subtests has been developed for this research. This battery, representing various intra- and intersensory learning functions had been previously utilized in unpublished pilot studies on a considerable number of children and adults with learning disorders at the Institute for Language Dsiorders. As a result of such studies the battery of tests was improved continually. Analysis of the most current version of this psychosensory battery of tests has been shown to have a high reliability. According to the Hoyt test of reliability estimated by analysis of variance, the coeficient for the overall battery is .83. This study provides further information as to the validity and reliability of these tests. A description of the battery is as follows.

Each stimulus utilized in the automated tests of intra- and intersensory learning functions must be described according to three dimensions:

(1) Sensory channel (auditory; visual; auditory-visual; visual-auditory)

(2) Meaningfulness (social or nonsocial)

(3) Symbolic value (verbal or nonverbal)

Our battery of tests included 13 subtests, according to these dimensions:

INTRASENSORY

Sensory Channel	Dimension	Test
AUDITORY	NONVERBAL (NONSOCIAL)	Frequency Patterns Test Duration Patterns Test
	NONVERBAL (SOCIAL)	Social Sounds Test
	VERBAL	Nonsense Syllables Test Words Test
VISUAL	NONVERBAL (NONSOCIAL)	Geometric Designs Test
	NONVERBAL (SOCIAL)	Pictures Test
	VERBAL	Nonsense Syllable Test Words Test

INTERSENSORY

Sensory Channels	Dimension	Test
AUDITORY-VISUAL	NONVERBAL (SOCIAL) VERBAL	Social Test Words Test
VISUAL-AUDITORY	NONVERBAL (SOCIAL) VERBAL	Social Test Words Test

For each of these tests there were 12 items presented to the subject, thus providing 156 test items per subject, according to the above classifications. A complete detailing of the nature of each item on the test battery is in Appendix Table I.

Examples of the above may be helpful. For all intrasensory tasks of an auditory nature the subject heard an initial stimulus through the headphones. He then heard a comparison stimulus and was asked to indicate whether it was the "same" or "different"/

A series of such presentations comprise one subtest. For the auditory channel the verbal stimuli are spoken words; non-verbal (social) stimuli are familiar environmental sounds (e.g., a car motor or a telephone); the nonverbal (non-social) stimuli are three-tone frequency patterns. In each instance, however, the subject heard two sounds of like class and indicated whether they were the "same" or "different".

Visual intrasensory tests were accomplished by a three choice task. The procedure was to present an initial stimulus picture, then three comparison pictures. The subject indicated which of the three comparison stimuli was "the same" as the initial stimulus. In a manner analogous to the stimuli for auditory presentations, visual verbal stimuli are printed words; the nonverbal-social pictures represent familiar objects in the environment; and the nonverbal-nonsocial stimuli are an array of geometric designs and figures.

Intersensory tasks utilized similar types of sounds and pictures, but the comparisons were made between senses, rather than within a sensory channel. The difference between auditory-visual (A-V) and visual-auditory (V-A) intersensory tasks was simply the order of presentation of the stimuli. Thus, for the A-V presentation of verbal material a spoken word was heard, followed by a printed word on the subject console..A "same" or "different" judgment was made. In contrast the printed word was followed by the spoken word for the V-A presentation.

A similar procedure was followed for intersensory comparisons of nonverbal (social) stimuli. In one instance the environmental sound might be heard, followed by a picture of some environmental object (A-V presentation); or the picture might precede the sound (V-A presentation). The individual tests are presented in Appendix Table I.

Psychoeducational Tests. This battery of tests was compiled for the LDS study to measure facility in the areas of auditory and visual perceptual skills, receptive and expressive language, academic achievement, verbal and non-verbal mental abilities, and social and emotional maturity. A list of the tests administered is given in Appendix Table II. The battery of tests required approximately five hours of tests and was administered individually.

RESULTS

The primary objective of this study was to compare visual and auditory learning processes in normal children and children with specific learning disabilities. It was hypothesized that children with learning disabilities would perform more poorly than normal children on automated measures of these processes. Means, standard deviations, and Student's t-tests were computed for each psychosensory test score in order to fulfill this objective. These were computed for the group of School Learning Disabilities, the group of Clinic Learning Disabilities, and the Control group of normal children. Each learning disability group was compared with the control group. Since a few differences were apparent between the age groups, the eight-year-olds and nine-year-olds were treated separately throughout the study. In no instance were they combined to form a total group for statistical comparison. The groups thus available for comparisons can be summarized as follows:

AGE	GROUP	N	MEAN AGE (YRS.)
Eight-year-old:	School learning disability	10	8.53
	Clinic learning disability	14	8.42
	Control	19	8.58
Nine-year old:	School learning disability	21	9.48
	Clinic learning disability	17	9.45
	Control	49	9.49

A total of 62 children with learning disabilities and 68 normal children were thus included in the evaluation. The mean ages were comparable in cases where comparisons were to be made, that is, there were no differences that were statistically significant.

Two kinds of scores were recorded for each psychosensory test:

(1) the number of errors made on the twelve items of the test; and

(2) the average response time for the twelve items of the test.

Tables 2 through 5 report the means, standard deviations and t-scores for the number of errors made on each of the 13 sub-tests of the psychosensory battery. Tables 6 through 9 indicate the same statistics for response times. In all cases, one-tailed tests of significance were applied, since the prediction was made that the Learning Disability children would do more poorly than the Control children on these tasks.

Error Score Analysis

Eight-year-olds. Results of error score comparisons for the eight-year-old children are reported in Table 2. It can be seen that no statistically significant differences for error scores occurred between the Control group and the School Learning Disability group (the children who were classified as having learning problems after screening and intensive evaluation in the public schools). In contrast, however, there were several significant differences between the Control group and the Clinic Learning Disability children, (those who were referred to a special clinic because of suggested learning disorders).

The psychosensory items which were more poorly performed by the eight-year-old Clinic Learning Disability Children were:

Nonsense Syllables (Visual-Visual)
Words (Visual-Visual)
Words (Auditory-Visual)
Words (Visual-Auditory)

Clearly, these children had significant difficulty in every instance in which visual symbols were utilized. The only subtests in which they performed adequately with symbols were those in which both comparison stimuli were presented auditorily (the Nonsense Syllables and Word tests in the Auditory-Auditory presentation sequence). All non-verbal subtests, regardless of the sensory presentation mode i.e., auditory intrasensory, visual intrasensory, or auditory visual intersensory were performed equally well by the Control group and the Clinic Learning Disability group.

The influence of each of these significant subtests can be seen in Table 3 where the scores have been combined according to the psychosensory modalities utilized. The visual intrasensory and the auditory-visual intersensory combinations showed significant differences for the Clinic Learning Disabilities whereas the auditory intrasensory tests did not. As with the specific tests, there were no significant differences for the School Learning Disability children at age eight.

Nine-year-olds. The error score analysis for nine-year-old children showed slightly different findings (Tables 4 and 5). For the School Learning Disability group some significant differences appeared. In every instance where visual words or symbols were presented, the School Learning Disability group did more poorly than the Control group. Only the Visual-Auditory mode of presentation failed to be statistically significant. Thus, the foll ing tests were performed more poorly by the School Learning Disability group:

TABLE 2

MEANS, STANDARD DEVIATIONS, AND *t*-SCORES FOR ERRORS OF EIGHT-YEAR-OLD CHILDREN ON PSYCHOSENSORY TESTS

Psychosensory Tests	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
AUDITORY-AUDITORY								
Frequency Patterns	1.42	1.27	1.67	1.63	1.86	2.33	-0.42	-0.67
Duration Patterns	5.53	1.90	6.00	1.33	5.64	1.76	-0.65	-0.17
Social Sounds	1.58	1.43	2.00	1.56	2.64	2.41	-0.68	-1.54
Nonsense Syllables	0.53	0.60	0.90	0.70	0.57	0.73	-1.46	-0.19
Words	0.68	1.17	0.60	1.28	1.00	1.73	0.17	-0.61
VISUAL-VISUAL								
Geometric Designs	1.11	1.02	1.50	2.29	1.64	1.04	-0.62	-1.44
Pictures	0.53	0.60	0.70	1.01	0.50	0.63	-0.56	0.12
Nonsense Syllables	2.42	1.43	3.20	1.40	4.07	1.22	-1.36	-3.38**
Words	0.58	0.82	1.20	1.33	2.71	1.94	-1.50	-4.17**
AUDITORY-VISUAL								
Social	1.44	0.96	1.78	1.03	1.50	1.05	-0.80	-0.15
Words	0.61	0.95	0.50	1.20	2.00	1.96	0.26	-2.55**
VISUAL-AUDITORY								
Social	2.42	1.18	2.70	2.00	2.64	1.63	-0.45	-0.44
Words	1.56	1.30	2.20	1.08	3.57	1.95	-1.29	-3.38**

**p less than .01

TABLE 3

MEANS, STANDARD DEVIATIONS, AND *t*-SCORES FOR COMBINED ERROR SCORES OF EIGHT-YEAR-OLD CHILDREN ON PSYCHOSENSORY TESTS

Psychosensory Modalities	Control Group (N=19)		Learning Disability Groups School (N=10)		Learning Disability Groups Clinic (N=14)		t-Scores Control vs. School	t-Scores Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
AUDITORY-AUDITORY	9.74	3.46	10.20	5.40	11.71	5.50	-0.27	-1.22
VISUAL-VISUAL	4.63	2.50	6.60	3.32	8.93	3.39	-1.73*	-4.06**
AUDITORY-VISUAL	1.95	1.19	2.10	1.38	3.50	1.80	-0.29	-2.88**
VISUAL-AUDITORY	3.90	1.74	4.90	2.59	6.21	2.21	-1.19	-3.26**

*p less than .05
**p less than .01

Nonsense Syllables (Visual-Visual)
Words (VIsual-Visual)
Words (Auditory-Visual)
Words (Visual-Auditory)

The fact that two visual intrasensory tasks were included is reflected in Table 5 where it can be seen that it was the only psychosensory modality of significance for the School Learning Disability children.

The nine-year-old Clinic Learning Disability children were significantly poorer than the normal children on the same four subtests:

Nonsense Syllables (Visual-Visual)
Words (Visual-Visual)
Words (Auditory-Visual)
Words (Visual-Auditory)

In addition, however, they were poorer than normal children on two auditory intrasensory subtests: Social Sounds and Nonsense Syllables. It appears that the nine-year-old Clinic children had more severe learning problems than their School Learning Disability counterparts. Their problems involved more than merely verbal or symbolic functions. This is reflected in the Combined Error Scores results in Table 5. The visual intrasensory and the auditory-visual intersensory combinations were all statistically significant, or nearly so. Even though two of the five auditory intrasensory subtests were performed more poorly by the Clinic children, the combined score for auditory intrasensory function was not significant.

Summary. A graphic summary of the error analysis is presented in Table 5.1. In total it can be seen that:

(1) Eight-year-old School Learning Disability children had no difficulty in performing any psychosensory tasks;
(2) Eight-year-old Clinic Learning Disability children had difficulties with visual intra- and intersensory verbal tasks;
(3) Nine-year-old School Learning Disability children had difficulty with visual intrasensory and auditory-visual intersensory verbal tasks;
(4) Nine-year-old Clinic Learning Disability children had difficulty with all verbal tasks.

In general, the Clinic Learning Disability children showed more psychosensory deficiencies than the School Learning Disability children and the nine-year-olds tended to demonstrate more errors than their eight-year-old counterparts.

TABLE 4

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR ERRORS OF NINE-YEAR-OLD CHILDREN ON PSYCHOSENSORY TESTS

Psychosensory Tests	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
AUDITORY-AUDITORY								
Frequency Patterns	1.22	1.49	1.14	1.28	1.41	1.75	0.22	-0.42
Duration Patterns	5.31	2.03	6.14	1.83	5.12	2.47	-1.60	0.31
Social Sounds	0.96	1.09	1.33	1.89	2.00	1.85	-1.03	-2.75**
Nonsense Syllables	0.48	0.71	0.52	1.10	1.06	1.70	-0.20	-1.91*
VISUAL-VISUAL								
Geometric Designs	0.63	0.75	0.67	0.78	0.41	0.49	-0.21	1.07
Pictures	0.18	0.44	0.29	0.55	0.41	0.77	-0.82	-1.47
Nonsense Syllables	2.08	1.40	2.71	1.45	3.94	1.35	-1.69*	-4.70**
Words	0.41	0.73	1.48	1.56	2.47	2.30	-3.85**	-5.44**
AUDITORY-VISUAL								
Social	1.86	1.21	1.86	1.78	1.35	0.97	0.00	1.53
Words	0.22	0.62	1.20	2.56	1.47	1.09	-2.46**	-5.69**
VISUAL-AUDITORY								
Social	2.31	1.33	2.24	1.82	1.88	1.68	0.17	1.04
Words	1.35	1.17	1.67	1.70	2.82	1.69	-0.89	-3.90**

*p less than .05
**p less than .01

TABLE 5

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR COMBINED ERROR SCORES OF NINE-YEAR-OLD CHILDREN ON PSYCHOSENSORY TESTS

Psychosensory Modalities	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
AUDITORY-AUDITORY	8.43	4.00	10.24	4.41	10.29	6.21	-1.67	-1.39
VISUAL-VISUAL	3.25	2.04	5.14	3.11	7.23	2.84	-2.97**	-6.14**
AUDITORY-VISUAL	2.08	1.48	3.00	4.09	2.82	1.69	-1.35	-1.68*
VISUAL-AUDITORY	3.65	1.92	3.91	3.15	4.71	2.95	-0.40	-1.65

*p less than .05
**p less than .01

TABLE 5.1

SUMMARY OF SIGNIFICANT t-SCORES FROM THE ERROR ANALYSIS

PSYCHOSENSORY MODALITIES	PSYCHOSENSORY TESTS	EIGHT-YEAR-OLDS Control vs: School	EIGHT-YEAR-OLDS Control vs: Clinic	NINE-YEAR-OLDS Control vs: School	NINE-YEAR-OLDS Control vs: Clinic
	Frequency Patterns				
	Duration Patterns				
	Social Sounds				
	Nonsense Syllables				**
	Words				*
AUDITORY-AUDITORY					
	Geometric Designs				
	Pictures				
	Nonsense Syllables		**	*	**
	Words		**	**	**
VISUAL-VISUAL			**	**	**
	Social				
	Words		**	**	**
AUDITORY-VISUAL			**		*
	Social				
	Words		**		**
VISUAL-AUDITORY			**		

* t-Score significant at the .05 level
** t-Score significant at the .01 level

Average Response Time Analysis

In addition to the error scores recorded for each subtest, it was possible to measure the latency or response time, that is, the time from presentation of the comparison stimuli to the time of response. These times were automatically recorded on our psychosensory examiner's console. This type of measurement is not possible with accuracy by means of a stop watch in an ordinaty psychometric examination. Because children with learning disabilities are suspected of having minimal brain dysfunction, it was felt that these reaction times might identify differences between groups that would not be detected on the basis of error analysis. The results support this hypothesis to some degree. The response times results are reported in Tables 6 through 9. It was expected that Learning Disability children would take longer times to respond. Therefore, one-tailed statistical tests were applied.

Eight-year-olds. The response time data for eight-year-old children are summarized in Tables 6 and 7. Although this age group of School Learning Disability children showed no significant differences for error scores as discussed above (Table 2), two significant differences were noted for response times. The Nonsense Syllables (Visual-Visual) and the Social test (Visual-Auditory) were performed faster by the children with learning disorders than by the normal children. Although these were the only significant subtests, in 10 of the 13 subtests the mean times for the Learning Disability children, who were detected through school screening, were faster than those for the normal children. Table 7 shows that the visual-visual intrasensory condition was significantly different between these groups, again with the Learning Disability children performing the tasks at a faster rate than the Normal or Control groups.

Thus, the psychosensory test battery failed to demonstrate poorer performances by the eight-year-old School Learning Disability group in any instance. The only differences noted were in favor of this group. Not only did they give as many correct answers as the Control group, as seen in the error analysis, but they did it faster on the whole. It must be concluded that neither error scores nor response times were of value in distinguishing between normal children and school children with learning disability at the age of eight years.

The eight-year-old Clinic Learning Disability children, however, showed decidedly more difficulty on psychosensory functions by the response time criterion. In every instance the average response times per subtest were slower for the Clinic Learning Disability group, as compared to the Control group. Of the 13 subtests, 9 showed differences that were

TABLE 6

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON PSYCHOSENSORY TESTS

Psychosensory Tests	Control Group (N=19)		Learning Disability Groups: School (N=10)		Learning Disability Groups: Clinic (N=14)		t-Scores	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Control vs. School	Control vs. Clinic
AUDITORY-AUDITORY								
Frequency Patterns	2.07	0.64	1.78	0.36	2.73	1.34	1.24	-1.80*
Duration Patterns	2.70	0.60	2.93	0.42	3.39	0.92	-1.00	-2.50**
Social Sounds	4.64	0.73	4.58	0.55	5.31	1.05	0.20	-2.09*
Nonsense Syllables	4.98	0.66	4.85	0.37	5.34	0.61	0.57	-1.54
Words	4.87	0.49	4.63	0.52	5.04	0.57	1.18	-0.91
VISUAL-VISUAL								
Geometric Designs	2.86	0.52	2.71	0.30	3.22	0.49	0.79	-1.96*
Pictures	2.43	0.46	2.39	0.29	2.94	0.59	0.22	-2.71**
Nonsense Syllables	3.94	0.70	3.36	0.52	4.33	0.96	2.22*	-1.29
Words	3.03	0.68	2.62	0.46	4.17	1.01	1.66	-3.75**
AUDITORY-VISUAL								
Social	3.23	0.82	3.11	0.96	3.34	0.68	0.31	-0.41
Words	2.32	0.59	2.57	0.69	3.11	0.77	-0.96	-3.19**
VISUAL-AUDITORY								
Social	5.36	0.81	4.65	0.80	5.88	0.76	2.17*	-1.82*
Words	5.39	0.55	5.45	0.47	6.06	0.95	-0.28	-2.41*

*p less than .05
**p less than .01

TABLE 7

MEANS, STANDARD DEVIATIONS, AND *t*-SCORES FOR COMBINED RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON PSYCHOSENSORY TESTS

Psychosensory Modalities	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)		Control vs. School	Control vs. School
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
AUDITORY-AUDITORY	3.85	0.52	3.83	0.40	4.37	0.69	0.11	-2.39*
VISUAL-VISUAL	3.14	0.49	2.80	0.24	3.68	0.69	1.98*	-2.56**
AUDITORY-VISUAL	2.80	0.58	2.87	0.55	3.46	0.99	-0.32	-2.33*
VISUAL-AUDITORY	5.40	0.59	5.07	0.45	5.80	0.99	1.50	-1.40

**p* less than .05
***p* less than .01

statistically significant. This is in distinct contrast to the four subtests found to be significant when error scores were used as the criterion (Table 2). The deficiencies in response time for the Clinic group were found in every intrasensory and intersensory condition. Whereas error scores were deficient only when verbal stimuli were presented, slower response times occurred for verbal and nonverbal stimuli. All of the intrasensory nonverbal tasks, whether auditory or visual, were performed more slowly by the Clinic group. The response time lags of the Clinic group are too generalized to be considered a function of any psychosensory condition. This generalized problem is reflected in Table 7, where three of the four psychosensory conditions showed statistically significant differences in favor of the normal children.

Nine-year-olds. The trends for response time analysis for the nine-year-old School Learning Disability children (Tables 8 and 9) were similar to those noted in their eight-year-old counterparts. That is, in most instances the learning disordered children responded faster than the normal-children (in 9 of 13 subtests). One of these, the Auditory-Auditory Social Sounds test, reached statistical significance.

The response time analysis for nine-year-old Clinic Learning Disability children revealed results of similar trend to that found for the same analysis in eight-year-old Clinic Learning Disability children. In all but one instance the average response times were slower for the Clinic Learning Disabilities group when compared to the children of the Control group. Five of these differences were statistically significant, and they were found in every possible psychosensory condition. The largest differences, however, were found for subtests involving words or nonsense syllables. When the combined scores were considered (Table 9) the Visual-Visual and Auditory-Visual conditions yielded significant differences.

The response time analysis yielded essentially the same results as error analysis for the nine-year-old Clinic Learning Disability children, with some minor variations.

Summary. A graphic summary of the above comparisons for response time analysis is presented in Table 9.1. In total it can be seen that:

(1) Eight-year-old School Learning Disability children performed two psychosensory tasks significantly faster than their Controls.
(2) Eight-year-old Clinic Learning Disability children performed more slowly in every dimension of psychosensory tasks than their Controls.
(3) Nine-year-old School Learning Disability children performed one psychosensory task significantly faster than their Controls.

TABLE 8

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON PSYCHOSENSORY TESTS

Psychosensory Tests	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
AUDITORY-AUDITORY								
Frequency Patterns	1.84	0.62	1.77	0.49	2.01	0.83	0.45	-0.89
Duration Patterns	2.69	0.71	2.83	0.57	3.00	0.86	-0.78	-1.44
Social Sounds	4.73	0.49	4.40	0.64	4.75	0.53	2.28*	-0.14
Nonsense Syllables	4.85	0.48	4.70	0.50	5.31	1.12	1.21	-2.29*
Words	4.84	0.54	4.69	0.47	5.02	0.71	1.12	-1.05
VISUAL-VISUAL								
Geometric Designs	2.71	0.40	2.59	0.47	2.98	0.47	1.11	-2.20*
Pictures	2.31	0.44	2.26	0.40	2.50	0.65	0.47	-1.32
Nonsense Syllables	3.54	0.84	3.42	0.83	3.86	0.92	0.54	-1.30
Words	2.65	0.57	2.78	0.68	3.42	0.68	-0.83	-4.53**
AUDITORY-VISUAL								
Social	2.78	0.65	3.00	1.13	3.02	0.78	-1.01	-1.25
Words	2.10	0.48	2.19	0.35	2.62	0.68	-0.68	-3.41**
VISUAL-AUDITORY								
Social	5.26	0.86	4.97	0.83	5.04	0.89	1.31	0.89
Words	5.22	0.58	5.15	0.50	5.84	0.81	0.44	-3.37**

*p less than .05
**p less than .01

TABLE 9

MEANS, STANDARD DEVIATIONS, AND *t*-SCORES FOR COMBINED RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON PSYCHOSENSORY TESTS

Psychosensory Modalities	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Control vs. School	Control vs. Clinic
AUDITORY-AUDITORY	3.79	0.46	3.68	0.31	4.01	0.59	1.00	-1.57
VISUAL-VISUAL	2.83	0.48	2.77	0.41	3.21	0.52	0.50	-2.64**
AUDITORY-VISUAL	2.47	0.49	2.62	0.56	2.95	0.76	-1.12	-2.97**
VISUAL-AUDITORY	5.27	0.59	5.09	0.58	5.37	0.93	1.15	-0.49

***p* less than .01

TABLE 9.1

SUMMARY OF SIGNIFICANT _t_-SCORES FROM THE RESPONSE TIME ANALYSIS

PSYCHOSENSORY MODALITIES	PSYCHOSENSORY TESTS	EIGHT-YEAR-OLDS Control vs: School	EIGHT-YEAR-OLDS Control vs: Clinic	NINE-YEAR-OLDS Control vs: School	NINE-YEAR-OLDS Control vs: Clinic
	Frequency Patterns		*		
	Duration Patterns		**		
	Social Sounds		*	(*)	
	Nonsense Syllables				*
	Words				
AUDITORY-AUDITORY			*		
	Geometric Designs		*		*
	Pictures		**		
	Nonsense Syllables	(*)			
	Words		**		**
VISUAL-VISUAL		(*)	**		**
	Social				
	Words		**		**
AUDITORY-VISUAL			*		**
	Social	(*)	*		
	Words		*		**
VISUAL-AUDITORY					

*_t_-Score significant at the .05 level
**_t_-Score significant at the .01 level

(*) Control group response times longer

(4) Nine-year-old Clinic Learning Disability children performed more slowly in every dimension of psychosensory tasks than their Controls. The largest differences were for verbal stimuli.

School Learning Disability children, then, tended to give faster responses than Controls, whereas the Clinic Learning Disabilities performed more slowly than the Controls.

A most persistent generalization was that the Clinic Learning Disability children not only performed their tasks more slowly, but they made more errors than the School Learning Disabilities. Response time criteria, however, did detect some differences not noted by error analysis alone.

These findings regarding the error and response time analyses represent the fulfillment of the first objective of the study, namely, to compare the normal and disabled learners on inter- and intrasensory functions.

Item Analysis

A second objective of this investigation was to generate normative data on the automated measurement tasks that had been devised. These data are necessary if such processes are to be used in identifying abnormal learning. The error analysis presented in Tables 2-5 and the Response time analyses in Tables 6-9 represent normal expectancies for our tests, based on 19 normal eight-year-olds and 49 normal nine-year-olds. In order to make improvements in our psychosensory battery for future investigations, we accomplished an extensive item-by-item analysis of each subtest. This was done for both error and response time scores by age and group.

A list designating the stimuli used for each test item is in Appendix Table I. There were 13 psychosensory subtests with 12 items in each, a total of 156 test items. Each was considered in the following analysis. The error score analysis provided few differences, therefore, no tabular presentation of these results is included.

The individual item analysis for error scores showed only two significant differences in the entire battery. Both were in favor of the Learning Disability Groups. Item Number One of the Auditory-Auditory Words test was performed better by the Clinic Learning Disability children at age eight. Item Number Twelve of the Visual-Auditory Social test was performed better by the School Learning Disability Children at age eight. These two significant differences out of 624 possibilities must be interpreted as chance occurrences. The overwhelming evidence is that no single item in the entire battery of 156 items differentiates between learning disabilities and normal children in terms of errors commited. A "one-item-test" is not feasible on the basis of these findings.

TABLE 10

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE FREQUENCY PATTERNS TEST (AUDITORY-AUDITORY)

	Eight-Year-Olds		Nine-Year-Olds	
Test Item	Control vs. School	Control vs. Clinic	Control vs. School	Control vs. Clinic
1		*		
2				
3				
4	(*)			
5				
6				**
7		*		*
8				
9		*		
10	(*)	*		
11		*		
12		*		

TABLE 11

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE DURATION PATTERNS TEST (AUDITORY-AUDITORY)

	Eight-Year-Olds		Nine-Year Olds	
Test Item	Control vs. School	Control vs. Clinic	Control vs. School	Control vs. Clinic
1				
2				
3		**		
4				
5				
6				
7				
8				
9		*		
10			*	
11		**		**
12				

* Significant difference in favor of Control subjects.

(*) Significant difference in favor of Learning Disability subjects. (One asterisk indicates significance at the .05 level; Two asterisks indicate significance at the .01 level.)

TABLE 12

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE SOCIAL SOUNDS TEST (AUDITORY-AUDITORY)

	Eight-Year-Olds		Nine-Year-Olds	
Test Item	Control vs. School	Control vs. Clinic	Control vs. School	Control vs. Clinic
1				
2				
3		*	(*)	
4		*	(*)	
5		*	(**)	*
6		**	(**)	
7			(*)	
8			(**)	
9			(*)	
10				
11		*		
12	(*)			

TABLE 13

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE NONSENSE SYLLABLES TEST (AUDITORY-AUDITORY)

	Eight-Year-Olds		Nine-Year-Olds	
Test Item	Control vs. School	Control vs. Clinic	Control vs. School	Control vs. Clinic
1		**	(*)	
2				**
3				
4				*
5				
6				
7	(*)			*
8				
9				
10				
11		*	(*)	
12		*	(**)	

* Significant difference in favor of Control subjects.
(*)Significant difference in favor of Learning Disability subjects
(One asterisk indicates significance at the .05 level;
Two asterisks indicate significance at the .01 level.)

TABLE 14

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE WORDS TEST (AUDITORY-AUDITORY)

	Eight-Year-Olds		Nine-Year-Olds	
Test Item	Control vs. School	Control vs. Clinic	Control vs. School	Control vs. Clinic
1				
2				
3				*
4				**
5				
6				
7				
8				
9				
10				
11				
12				

TABLE 15

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE GEOMETRIC DESIGNS TEST (VISUAL-VISUAL)

	Eight-Year-Olds		Nine-Year-Olds	
Test Item	Control vs. School	Control vs. Clinic	Control vs. School	Control vs. Clinic
1			(*)	
2				
3		*		**
4				
5	(*)			**
6		*		
7				
8		**		**
9		*		**
10				
11		**		**
12		**	(*)	

* Significant difference in favor of Control subjects.
(*)Significant difference in favor of Learning Disability subjects.
(One asterisk indicates significance at the .05 level;
Two asterisks indicate significance at the .01 level.)

TABLE 16

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE PICTURES TEST (VISUAL-VISUAL)

	Eight-Year-Olds		Nine-Year-Olds	
Test Item	Control vs. School	Control va. Clinic	Control vs. School	Control vs. Clinic
1		*		
2		**		
3		**		
4		**		
5		*		
6		**		
7				
8			(*)	
9				
10		*		
11				
12				

TABLE 17

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE NONSENSE SYLLABLES TEST (VISUAL-VISUAL)

	Eight-Year-Olds		Nine-Year-Olds	
Test Item	Control vs. School	Control vs. Clinic	Control vs. School	Control vs. Clinic
1		*		
2		**		**
3		**		**
4				*
5				**
6				
7	(*)			
8				
9	(**)			
10				
11				
12				

* Significant difference in favor of Control subjects.
(*)Significant difference in favor of Learning Disability subjects.
(One asterisk indicates significance at the .05 level;
Two asterisks indicate significance at the .01 level.)

TABLE 18

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE WORDS TEST (VISUAL-VISUAL)

Test Item	Eight-Year-Olds Control vs. School		Nine-Year-Olds Control vs. School	
		Control vs. Clinic		Control vs. Clinic
1	(**)	**		*
2		**		*
3				**
4		**		**
5		**		**
6				**
7		*		**
8				**
9		**		
10		**		**
11				**
12	(*)	*		

TABLE 19

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE SOCIAL TEST (AUDITORY-VISUAL)

Test Item	Eight-Year-Olds Control vs. School		Nine-Year-Olds Control vs. School	
		Control vs. Clinic		Control vs. Clinic
1				
2				*
3				
4				
5				
6				
7				*
8	(*)			
9				
10				
11				
12				

* Significant difference in favor of Control subjects.
(*)Significant difference in favor of Learning Disability subjects.
(One asterisk indicates significance at the .05 level;
Two asterisks indicate significance at the .01 level.)

TABLE 20

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE WORDS TEST (AUDITORY-VISUAL)

	Eight-Year-Olds		Nine-Year-Olds	
Test Item	Control vs. School	Control vs. Clinic	Control vs. School	Control vs. Clinic
1				
2				
3				
4		*		*
5		*		
6		**		
7				**
8		*	*	**
9		**		**
10		**	*	**
11				**
12				

TABLE 21

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE SOCIAL TEST (VISUAL-AUDITORY)

	Eight-Year-Olds		Nine-Year-Olds	
Test Items	Control vs. School	Control vs. Clinic	Control vs. School	Control vs. Clinic
1	(*)	*	(**)	
2		*		
3				
4				(*)
5				*
6		*		
7				
8				
9		*		
10				
11				(*)
12				

* Significant difference in favor of Control subjects.
(*)Significant difference in favor of Learning Disability subjects.
(One asterisk indicates significance at the .05 level;
Two asterisks indicate significance at the .01 level.)

TABLE 22

SUMMARY OF INDIVIDUAL TEST ITEMS FOR WHICH RESPONSE TIMES WERE SIGNIFICANTLY DIFFERENT BETWEEN GROUPS ON THE WORDS TEST (VISUAL-AUDITORY)

	Eight-Year-Olds		Nine-Year-Olds	
Test Item	Control vs. School	Control vs. Clinic	Control vs. School	Control vs. Clinic
1		**		*
2		**		
3		**		**
4		**		*
5				**
6				
7		**		
8				
9				*
10		*		**
11				
12				

* Significant difference in favor of Control subjects.
(*) Significant difference in favor of Learning Disability subjects.
(One asterisk indicates significance at the .05 level;
Two asterisks indicate significance at the .01 level.)

The response time raw data are presented in Appendix Tables 2 through 27. The significant test items according to these response times are indicated in Tables 10 through 22. No attempt is made to interpret trends of these analyses.

The item-by-item charts (Tables 10-22) merely indicate to the reader the specific test items which were responsible for significant differences on the test analyses. They are provided so that a guide may be available for the construction of more sensitive psychosensory test items. The response time items which are starred in the tables should serve as examples or prototypes of the kinds of items that should be included in future batteries of this nature.

Psychoeducational Test Findings

Another objective of this investigation was to compare the results of traditional psychoeductional evaluation with those from our unique psychosensory test battery. This was done with the School Learning Disability groups only. Although we originally intended also to study neurologic, electroencephalographic, pediatric and ophthalmological data from a companion study, problems in the collection of that data prevented us from making this analysis. For example, the unreliabilities mentioned previously would indicate that use of such data might be tenuous. The results and comparisons of the psychoeducational data are presented in Tables 23 through 28. They include consideration of mental ability, academic achievement, language ability, learning aptitude, motor ability, emotional status, and social maturity. Following is a discussion of those results. Since children with learning disabilities were expected to do more poorly, one-tailed statistical tests were applied.

Mental Ability. The assessment of mental ability will be considered first, (Tables 23 and 24). The Wechsler Intelligence Scale for Children (WISC) and the SRA Primary Mental Abilities test (PMA) were administered to each child.

Among the eight-year-old children only one IQ score showed a statistical difference, that being the Perceptual IQ score in favor of the Control group. Two WISC subtests, Information and Mazes, were also performed lower by this School Learning Disability group.

In contrast, the nine-year-old School Learning Disability group showed many differences from the Control group in mental ability. Every IQ score was statistically superior for the Control group. Thus, the Verbal IQ, Performance IQ and Full

TABLE 23

SUMMARY OF COMPARISONS BETWEEN THE CONTROL GROUP AND THE SCHOOL LEARNING DISABILITY GROUP FOR MEASURES OF MENTAL ABILITY IN EIGHT-YEAR-OLD CHILDREN

Test Scores	Control (N=19) Mean	Control (N=19) S.D.	Learning Disability (N=10) Mean	Learning Disability (N=10) S.D.	t-Scores
WECHSLER VERBAL SCALED SCORES					
Information	12.53	2.39	11.00	1.73	1.72*
Comprehension	10.32	2.13	9.80	1.40	0.67
Arithmetic	11.90	3.02	11.10	2.43	0.69
Similarities	12.47	3.15	12.60	2.84	0.10
Vocabulary	12.16	2.89	11.70	2.57	0.40
Digit Span	10.16	2.21	11.50	2.54	1.42
WECHSLER PERFORMANCE SCALED SCORES					
Picture Completion	10.21	2.38	8.70	2.33	1.58
Picture Arrangement	11.16	3.88	10.80	2.79	0.25
Block Design	11.47	2.68	10.10	3.33	1.16
Object Assembly	11.37	3.06	9.80	3.60	1.18
Coding	12.37	2.80	11.80	2.71	0.50
Mazes	10.58	2.56	8.60	2.76	1.85*
WECHSLER IQ SCORES					
Verbal IQ	109.95	12.09	108.00	6.36	0.47
Performance IQ	108.37	14.21	99.90	12.83	1.52
Full Scale IQ	110.32	12.30	104.90	8.74	1.19
PRIMARY MENTAL ABILITIES IQ SCORES					
Verbal	104.84	12.08	98.50	9.85	1.37
Spatial	104.95	14.07	102.20	20.76	0.41
Perceptual	100.53	7.27	94.20	11.93	1.70*

*p less than .05

TABLE 24

SUMMARY OF COMPARISONS BETWEEN THE CONTROL GROUP AND THE SCHOOL LEARNING DISABILITY GROUP FOR MEASURES OF MENTAL ABILITY IN NINE-YEAR-OLD CHILDREN

Test Scores	Control (N=49)		Learning Disability (N=21)		t-Scores
	Mean	S.D.	Mean	S.D.	
WECHSLER VERBAL SCALED SCORES					
Information	13.29	2.89	11.81	1.84	2.13*
Comprehension	10.45	2.48	10.62	2.50	0.26
Arithmetic	12.82	2.42	11.48	2.34	2.11*
Similarities	12.61	2.50	11.81	2.70	1.18
Vocabulary	13.65	2.34	12.24	2.09	2.36*
Digit Span	11.82	3.05	10.86	2.25	1.27
WECHSLER PERFORMANCE SCALED SCORES					
Picture Completion	10.49	2.67	9.67	2.36	1.20
Picture Arrangement	11.65	2.35	11.24	2.83	0.62
Block Design	12.22	2.61	10.29	2.66	2.79**
Object Assembly	11.33	2.86	10.57	3.14	0.96
Coding	13.82	2.83	12.67	2.36	1.60
Mazes	10.33	2.18	10.29	2.88	0.06
WECHSLER IQ SCORES					
Verbal IQ	115.39	11.05	109.38	8.39	2.19*
Performance IQ	113.70	9.99	105.62	10.55	2.13*
Full Scale IQ	114.88	9.69	108.24	7.61	2.75**
PRIMARY MENTAL ABILITIES IQ SCORES					
Verbal	112.51	13.20	106.33	12.18	1.80*
Spatial	108.02	15.72	98.62	15.50	2.26*
Perceptual	104.41	10.19	99.62	11.21	1.72*

*p less than .05
**p less than .01

Scale IQ from the WISC, together with the Verbal, Spatial, and Perceptual IQs from the PMA were all lower for the School Learning Disability group. Significant subtests in which they were also inferior were Information, Arithmetic, Vocabulary, and Block Design. All except the latter subtest were from the Verbal Scale.

Academic Achievement and Language Ability. Academic achievement and language ability were also more deficient in the nine-year-old School Learning Disabilities group than in the eight-year-old School Learning Disabilities group, when compared with their respective control groups. These data are summarized in Tables 25 and 26.

For the eight-year-old group the only significant differences were in measures of reading and spelling. The reading vocabularly, reading comprehension and nonsense words (Gates-McKillop) scores were lower for the learning disabled children. One of the Gates-Russel Oral Spelling subtests (Two Syllables) was also significantly lower for this group.

Many significant differences were noted for the nine-year-old School Learning Disabilities group. The Control group proved to be superior to the children with learning disorders for every measure of reading, most measures of spelling, arithmetic, oral language, and syntax for written language. Clearly, this was a group of children with learning disability, as was intended by their selection. It appears, however, that the nine-year-old children with learning disability had more types of disability with greater severity than the eight-year-olds.

Learning Aptitude, Motor Ability, Emotional Status, and Social Maturity. Learning aptitude was estimated by the Detroit Test of Learning Aptitude; motor ability by the Heath Railwalking test; emotional status at the examination time by the Anxiety Score of the Children's Personality Questionnaire; and social maturity by the Vineland Social Maturity Scale. The results of these evaluations are presented in Tables 27 and 28.

The eight-year-old School Learning Disability group was inferior to their Control group on only two tests from the above-mentioned factors. On the Detroit tests they did more poorly in Memory for Designs and Orientation.

The nine-year-old School Learning Disability group performed more poorly than the Control group on three tests from the Detroit battery: Auditory Sentences (memory), Memory for Designs, and Verbal Opposites. In addition, they demonstrated poorer social maturity.

TABLE 25

SUMMARY OF COMPARISONS BETWEEN THE CONTROL GROUP AND THE SCHOOL LEARNING DISABILITY GROUP FOR MEASURES OF ACADEMIC ACHIEVEMENT AND LANGUAGE ABILITY IN EIGHT-YEAR-OLD CHILDREN

Test Scores	Control (N=19) Mean	Control (N=19) S.D.	Learning Disability (N=10) Mean	Learning Disability (N=10) S.D.	t-Scores
Age at Exam (Yrs.)	8.59	0.26	8.61	0.23	0.20
READING					
Vocabulary Age	10.11	1.31	8.38	0.81	3.67**
Comprehension Age	9.72	1.32	8.21	0.84	2.96**
Wide Range Oral Score	63.05	13.56	58.80	11.88	0.80
Gates-McKillop					
Word Parts Score	19.11	3.61	17.40	5.94	0.92
Nonsense Words Score	17.63	2.68	15.30	3.52	1.92*
Syllabication Score	13.53	5.04	14.10	3.89	0.30
SPELLING					
Metropolitan Written	19.79	14.98	26.10	9.15	1.17
Gates Russell:Oral	9.79	7.42	12.40	5.92	0.93
One Syllable	8.53	1.69	7.25	2.80	1.47
Two Syllable	5.71	1.32	3.70	2.40	2.80**
WRITTEN LANGUAGE					
Total Words	67.63	37.41	47.50	27.16	1.45
Words Per Sentence	9.05	2.27	9.25	4.04	0.16
Syntax	95.58	3.80	93.60	3.90	1.27
Abstract-Concrete	12.68	5.28	10.20	2.60	1.35
ARITHMETIC					
Metropolitan Computation Score	22.53	10.10	16.60	6.83	1.60
ORAL LANGUAGE					
Kent EGY(Scale D)Score	16.84	6.52	14.00	3.98	1.21

*p less than .05
**p less than .01

TABLE 26

SUMMARY OF COMPARISONS BETWEEN THE CONTROL GROUP AND THE SCHOOL LEARNING DISABILITY GROUP FOR MEASURES OF ACADEMIC ACHIEVEMENT AND LANGUAGE ABILITY IN NINE-YEAR-OLD CHILDREN

Test Scores	Control (N=49)		Learning Disability (N=21)		t-Scores
	Mean	S.D.	Mean	S.D.	
Age at Exam (Yrs.)	9.32	0.52	9.60	0.36	2.12*
READING					
Vocabulary Age	10.92	1.43	9.81	1.30	3.54**
Comprehension Age	10.70	2.00	9.39	0.96	2.86**
Wide Range Oral Score	70.00	9.14	65.00	6.96	2.21*
Gates-McKillop					
Word Parts Score	19.57	4.60	16.95	4.17	2.21*
Nonsense Words Score	18.51	1.90	17.29	2.19	2.32*
Syllabication Score	15.41	4.47	13.29	3.84	1.87*
SPELLING					
Metropolitan Written	21.27	18.13	29.76	7.64	2.04*
Gates-Russell:Oral	11.06	10.15	13.81	5.67	1.14
One Syllable	8.94	1.39	7.93	1.60	2.62**
Two Syllable	6.25	1.77	4.79	1.74	3.13**
WRITTEN LANGUAGE					
Total Words	78.45	52.67	94.43	65.02	1.06
Words Per Sentence	10.11	3.15	10.11	2.20	0.00
Syntax	94.37	5.01	91.71	4.97	2.00*
Abstract-Concrete	15.61	4.62	13.81	4.95	1.44
ARITHMETIC					
Metropolitan Computation Score	34.37	10.91	26.71	10.84	2.65**
ORAL LANGUAGE					
Kent EGY(Scale D) Score	22.57	5.23	17.19	6.27	3.65**

*p less than .05
**p less than .01

TABLE 27

SUMMARY OF COMPARISONS BETWEEN THE CONTROL GROUP AND THE SCHOOL LEARNING DISABILITY GROUP FOR MEASURES OF LEARNING APTITUDE, MOTOR ABILITY, EMOTIONAL STATUS, AND SOCIAL MATURITY IN EIGHT-YEAR-OLD CHILDREN

Test Scores	Control (N=19)		Learning Disability (N=10)		t-Scores
	Mean	S.D.	Mean	S.D.	
DETROIT TESTS OF LEARNING APTITUDE					
Auditory Words (Simple)	44.21	6.61	42.10	6.16	0.81
Auditory Sentences	60.89	13.42	52.90	14.96	1.41
Span for Letters	14.68	2.79	14.00	1.73	0.68
Memory for Designs	24.53	5.74	16.70	6.96	3.12**
Oral Directions	9.16	3.96	8.70	3.95	0.28
Verbal Opposites	39.58	9.28	38.40	4.98	0.36
Free Association	45.58	13.94	42.20	10.21	0.65
Orientation	34.90	3.88	31.70	2.90	2.20*
MOTOR ABILITY					
Heath Railwalking Score	66.32	25.06	59.70	24.22	0.66
EMOTIONAL STATUS					
Children's Personality Questionnaire Anxiety Score	29.18	5.18	28.60	6.25	0.26
SOCIAL MATURITY					
Vineland Social Quotient	108.53	9.58	106.00	9.02	0.66

*p less than .05
**p less than .01

TABLE 28

SUMMARY OF COMPARISONS BETWEEN THE CONTROL GROUP AND THE SCHOOL LEARNING DISABILITY GROUP FOR MEASURES OF LEARNING APTITUDE, MOTOR ABILITY, EMOTIONAL STATUS, AND SOCIAL MATURITY IN NINE-YEAR-OLD CHILDREN

	Control (N=49)		Learning Disability (N=21)		t-Scores
Test Scores	Mean	S.D.	Mean	S.D.	
DETROIT TESTS OF LEARNING APTITUDE					
Auditory Words(Simple)	45.49	7.09	44.86	5.26	0.36
Auditory Sentences	70.57	14.39	62.62	13.98	2.10*
Span for Letters	16.31	3.47	15.95	3.55	0.38
Memory for Designs	28.80	7.31	21.19	6.23	4.10**
Oral Directions	11.69	4.43	9.86	7.59	1.24
Verbal Opposites	46.43	6.87	43.05	6.10	1.92*
Free Association	51.59	12.63	51.24	17.99	0.09
Orientation	36.06	3.40	35.19	2.46	1.04
MOTOR ABILITY					
Heath Railwalking Score	73.49	26.12	64.29	24.49	1.35
EMOTIONAL STATUS					
Children's Personality Questionnaire Anxiety Score	29.72	5.67	32.17	6.59	1.54
SOCIAL MATURITY					
Vineland Social Quotient	104.12	10.16	98.24	9.50	2.23*

*p less than .05
**p less than .01

It was intended that similar analysis would be possible for the Clinic Learning Disability groups. However, because of inequalities in the test items administered and variations in the ages at which they were seen for clinical evaluation, such analysis was found to be impractical and unbeneficial.

Summary. There were no differences between eight-year-old School Learning Disability children and Control children for accuracy of performance of psychosensory functions, as discussed above (see Table 5.1). Yet, the psychological testing indicated that the Learning Disability group was inferior in some measures of intelligence (Table 23); reading and spelling (Table 25), and memory for designs and orientation (Table 27).

For the eight-year-olds, then, we found the psychosensory tests less useful than traditional psychoeducational tests in discerning differences between these groups.

Nine-year-old School Learning Disability children, as seen in Table 5.1 demonstrated some significant errors with verbal psychosensory functions. However, they exhibited many more deficiencies, according to standard psychoeducational comparisons with normal children. These included all IQ scores computed, plus a number of specific mental ability subtests - predominately verbal (Table 24); reading, spelling, arithmetic, oral and written language (Table 26); and certain specific learning aptitudes and social maturity (Table 28).

As with the eight-year-olds, the psychoeducational tests were much more successful in measuring the manifestations of learning disability than were tests of specific psychosensory functions. We believe that the tasks presented by the psychosensory instrumentation were not of sufficient level of difficulty to provide useful assessment of psychosensory functions. The low number of persons failing individual items as per our item-by-item analysis, together with the low numbers of average errors on the various tests (Tables 2 and 4), would seem to support this. It is our feeling that the levels of difficulty of the subtests need to be increased.

Parameters of Intra- and Intersensory Functions. A fourth objective of our study was to define the parameters of intra- and intersensory functions among normal and learning disability children. Because of the minimum numbers of errors noted for most individual subtests, we did not feel that such definitions of psychosensory abilities could be drawn on the basis of our data. Further refinement of technique will be necessary. It should be mentioned, however, that there was a strong tendency for problems to follow a pattern according to dimension rather than psychosensory modality. That is, there were many trends for verbal errors, regardless of the psychosensory avenuee of inter- and intrasensory functions. It may be that the verbal or symbolic quality of stimulus may have more relevance than the sensory channel through which it is communicated.

Classification of Learning Disability. A final objective had been to suggest refinements in the classification of types of learning disability. However, we did not feel that our results were suitable for such an analysis at this time. Therefore, this objective of the study was unable to be met. We do feel that further changes in our psychosensory battery will allow for such an analysis and work is continuing along this vein.

DISCUSSION

One of the objectives of this investigation was to compare the psychosensory abilities of normal children with those of two types of learning disability children. This was accomplished and represents the major aspect of this study. These comparisons indicated that children defined as learning disabilities through different processes (school screening and intensive psychoeducational testing vs. clinical determination of disorders among children referred because of suspected problems) may in fact represent different populations. The clinic learning disability children tended to have more severe problems and more types of disabilities, when compared with normal children, than did the school learning disability children. Part of these differences may be attributed to the procedures employed in selecting the learning disabilities. Those sent to the clinic had been considered by teachers, parents, or others to have learning problems. They, therefore, were already known to be functioning at low levels, according to their grade placement, etc. In most instances they were performing below grade and age level. The School Learning Disability group, by contrast, consisted of children who were not known to have problems until a comprehensive survey in the schools detected them. They were defined as learning disabilities because some area of educational and/or language achievement was below expectancy for their combined age, grade placement and intelligence. Many of these children were performing nearly at age level in educational skills,but they qualified as learning disabilities because they were not performing educationally at a level equivalent to their mental age. It is apparent that their problems were more subtle and probably due to different reasons than the clinical group of learning disabilities.

A second objective, that of providing normative data on psychosensory functions was fulfilled through the tabular presentations of error analysis and response times for the eight-year-old and nine-year-old Control children. Further refinements are being made in our psychosensory battery, based on these data.

Another important objective of this study was to compare psychosensory functions with psychoeducational processes. The results indicated that psychosensory assessment in general did not contribute additionally to the designation and/or understanding of learning disabilities, since thorough psychoeducational assessment had been accomplished. In most instances the areas of failure for psychosensory functions were equivalent to the failures noted in the traditional psychoeducational examinations. The notable exception, however, was the use of latency, or response time as an index. There were numerous instances in which this criterion measure appeared to be useful in distinguishing between groups. This also was supported by the item analysis. It is felt that future investigation should be made as to the usefulness of response time measures in learning disabilities.

The intent also was to compare psychosensory and psychoeducational findings to information from medical evaluations of children with learning disabilities. This was to have been done by utilizing data from a companion investigation. As the results of that study became known, however, the reliability and discriminability of the medical findings were such that their use for our purposes was questioned. As a result, this objective of our study was not pursued. Details of this data will be published in another study. We might say, however, that educators should continue to use an "educational" definition of learning disability for planning and placement purposes. Medical definition is yet to be proven for such purposes, although it has very important and meaningful theoretical implications.

It was also proposed that the study would enable us to define the parameters of psychosensory functioning among children with learning disabilities. This objective was hampered by two factors: (1) The level of sophistication of the psychosensory test items. It has been concluded that the specific test batteries need further revision if they are to contribute effectively to the understanding of psychosensory processes. In many instances the items were too easy. The low level of difficulty of the items did not allow for meaningful discrimination in many subtests. It also impeded the possibility of generating useful standard scores as a method of comparing psychosensory areas directly. (2) The methods of selecting children with learning disability. Selection processes may also have contributed to the obscuring of real differences that existed among individual children. Children were grouped as one entity, although their major difficulty may have been in reading, arithmetic, spelling, or other specific learning functions. Some consideration should be made for evaluating the psychosensory processing of "individual" children and relating this to psychoeducational information.

Although correlational studies and discriminant analysis together with further attempts to subclassify children with learning disorders had been anticipated in this project, we did not feel that our data justified these additional analyses. Any such procedures must wail until psychosensory functions can be better defined and measurement of these functions is improved. Much more remains to be accomplished in the area of defining and describing the psychosensory processing of information by children with learning disabilities. Our study techniques manifested largely problems in verbal stimuli, a fact that is quite compatible with the psychoeducational problems demonstrated by our populations.

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APPENDIX TABLE I

TEST BATTERY KEY

AUDITORY INTRASENSORY TESTS

NONVERBAL (NONSOCIAL)
Frequency Patterns Test

	Auditory Presentation	VS.	Auditory Presentation
1.	ACA		ACC
2.	BCA		AAB
3.	CCB		CCB
4.	ABB		CCB
5.	CCA		CCB
6.	BAA		BAB
7.	BBA		BCC
8.	BDA		BBC
9.	CBA		CBA
10.	ACB		CCC
11.	CAB		CAB
12.	BBA		BAA

Duration Patterns Test

	Auditory Presentation	VS.	Auditory Presentation
1.			---
2.	.-.		...
3.	.--		-.-
4.	.-.		.-.
5.	.--		.--
6.	...		...
7.	-.-		-..
8.	.-.		---
9.	.-.		.--
10.	.--		.-.
11.	..-		..-
12.	.--		...

NONVERBAL (SOCIAL)
Social Sounds Test

	Auditory Presentation	VS.	Possible Auditory Match
1.	running up stairs		running down stairs
2.	adult conversation		children playing
3.	steam engine		steam engine
4.	chicken		turkey
5.	train whistle		different train whistle
6.	alarm clock ringing		telephone ringing
7.	boat horn		same boat horn
8.	one dog barking		dogs barking
9.	gong low		gong high
10.	bird singing		birds singing
11.	telephone ring		ring through receiver
12.	street rain		street rain

APPENDIX TABLE I (continued)

TEST BATTERY KEY

VERBAL

Nonsense Syllables Test

	Auditory Presentation	VS.	Auditory Presentation
1.	es		ech
2.	ig		ig
3.	ud		id
4.	doke		doke
5.	bydo		bydo
6.	oso		eso
7.	theetoo		seetoo
8.	marrow		marrow
9.	ado		ako
10.	inre		unre
11.	lahpoda		paloda
12.	resoday		resoday

Words Test

	Auditory Presentation	VS.	Auditory Presentation
1.	puppy		kitty
2.	fat		fat
3.	stop		step
4.	plate		plane
5.	wash		wash
6.	butter		rudder
7.	spread		spread
8.	slipper		slither
9.	shred		shed
10.	section		selection
11.	elephant		elephant
12.	excitement		accident

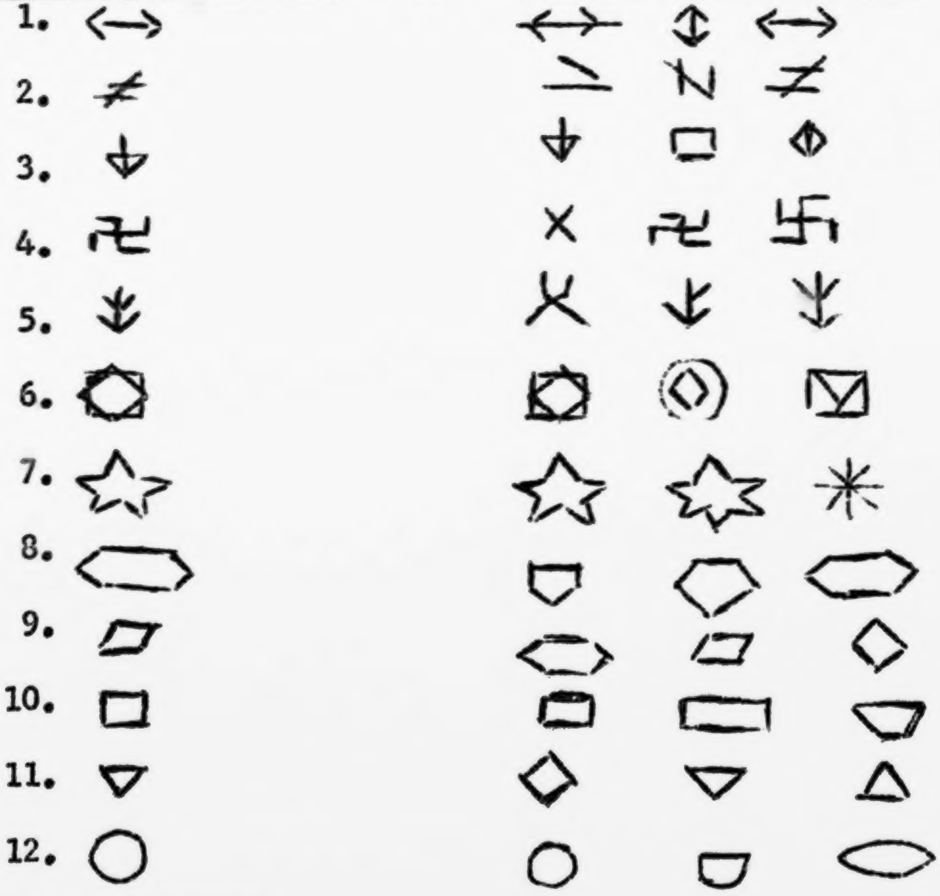
APPENDIX TABLE I (continued)

TEST BATTERY KEY

VISUAL INTRASENSORY TESTS

NONVERBAL (NONSOCIAL)
Geometric Design Test

Visual Presentation VS. Possible Visual Match



NONVERBAL (SOCIAL)
Pictures Test

	Visual Presentation	VS.	Possible Visual Match		
1.	apple		lemon	orange	apple
2.	adults		adults	birds flying	skier
3.	postman		soldier	pilot	postman
4.	sink		sink	bathtub	toilet
5.	stove		cupboard	stove	refrigerator
6.	bed		table	bed	sofa
7.	steamer		barge	sailboat	steamer
8.	airplane		bird	airplane	kite
9.	man		boy	Santa Claus	man
10.	car		car	truck	fireman
11.	woman		girl	baby	woman
12.	telephone		telephone	cow	train

APPENDIX TABLE I (continued)

TEST BATTERY KEY

VERBAL

Nonsense Syllable Test

	Visual Presentation	VS.	Possible Visual Match		
1.	ot		et	ot	ta
2.	ec		ce	oc	ec
3.	kai		aik	kai	oik
4.	qued		quep	queb	qued
5.	sopa		sopa	osba	paso
6.	aeux		aeux	aeuz	euxa
7.	jodat		jodat	jobat	jadot
8.	wascos		wascos	scawos	woscos
9.	lytogo		lytogo	tylogo	lytaga
10.	fohlawa		fonlawa	fohlawa	fohlava
11.	gertano		gertano	geratno	gertauo
12.	immollaz		immollaz	immollaz	immollaz

Words Test

	Visual Presentation	VS.	Possible Visual Match		
1.	no		on	in	no
2.	am		an	am	ma
3.	saw		was	sew	saw
4.	from		from	form	farm
5.	ship		ship	slip	shop
6.	stop		pots	stop	step
7.	three		there	tree	three
8.	flight		flight	fright	fight
9.	quiet		quite	quiet	quit
10.	spring		spring	string	sling
11.	product		protect	produce	product
12.	through		thorough	through	though

AUDITORY-VISUAL INTERSENSORY

NONVERBAL (SOCIAL)

Social Test

	Auditory Presentation	VS.	Visual Presentation
1.	glass breaking		broken glass
2.	whistling teakettle		percolator
3.	hammering		snare drum
4.	jet		jet
5.	bird		pig
6.	horse		horse
7.	model T		model T
8.	pistol shots		pistol smoking
9.	pouring water		pouring water (into glass)
10.	sports car		tractor
11.	basketball		tennis player
12.	windshield wiper		harp

APPENDIX TABLE I (continued)

TEST BATTERY KEY

VERBAL
Words Test

Auditory Presentation	VS.	Visual Presentation
1. bring		bring
2. dig		dog
3. came		come
4. cherry		carry
5. saw		see
6. down		down
7. house		horse
8. thread		thread
9. letter		lesson
10. ground		ground
11. rather		gather
12. something		anything

VISUAL-AUDITORY INTERSENSORY

NONVERBAL (SOCIAL)
Social Test

Visual Presentation	VS.	Auditory Presentation
1. vacuum cleaner		vacuum cleaner
2. coach whistle		factory whistle
3. hand lawnmower		car motor
4. fire in fireplace		electric typewriter
5. boat		car horn
6. geese		geese honks
7. steam shovel		power saw
8. steam locomotive		steam locomotive
9. tower clock		big ben
10. hammering		hammering
11. church with chimes		door chimes
12. manual typewriter		manual typewriter

VERBAL
Words Test

Visual Presentation	VS.	Auditory Presentation
1. am		ma
2. pat		tap
3. stop		stop
4. sing		thing
5. sip		sip
6. take		cake
7. shred		shred
8. motion		motion
9. tread		thread
10. flow		flow
11. where		which
12. mountain		money

APPENDIX TABLE II

PSYCHOEDUCATIONAL TESTS ADMINISTERED TO SUBJECTS

Wechsler Intelligence Test for Children; The Psychological Corporation, 1949
Detroit Test of Learning Aptitude; Bobbs-Merrill, 1959
  Subtests: Verbal Opposites
    Auditory Attention Span for Unrelated Words
    Visual Attention Span for Objects
    Orientation
    Free Association
    Designs
    Auditory Attention Span for Related Syllables
    Visual Attention Span for Letters
    Oral Directions
Kent Emergency Scale; The Psychological Corporation, 1946
    Scales C and D
Gates-MacGinitie Reading Series: Bureau of Publications, Columbia University, 1966
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APPENDIX TABLE III

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE FREQUENCY PATTERNS TEST (AUDITORY-AUDITORY)

Test Item	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	2.95	1.50	2.24	0.52	4.47	2.68	1.21	-1.87*
2	3.11	2.30	2.23	0.65	2.66	1.79	1.03	0.56
3	2.12	1.66	1.67	0.56	2.54	1.93	0.76	-0.64
4	1.92	0.84	1.36	0.41	2.32	1.56	1.70*	-0.92
5	2.13	0.83	1.68	0.66	2.64	1.46	1.36	-1.22
6	2.10	0.63	2.06	0.78	2.83	1.78	0.17	-1.54
7	1.80	0.57	1.99	0.47	2.74	1.89	-0.85	-1.98*
8	2.04	0.98	1.50	0.33	2.86	1.96	1.54	-1.53
9	1.54	0.40	1.51	0.57	2.63	1.84	0.13	-2.42*
10	1.77	0.46	1.40	0.53	2.23	0.95	1.80*	-1.73*
11	1.53	0.47	1.63	0.59	1.90	0.73	-0.47	-1.70*
12	1.88	0.61	2.08	0.43	2.62	1.09	-0.82	-2.39*

*p less than .05

APPENDIX TABLE IV

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE DURATION PATTERNS TEST (AUDITORY-AUDITORY)

Test Item	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	3.39	1.27	3.77	1.67	3.99	1.02	-0.62	-1.33
2	3.01	0.72	3.01	0.80	3.39	1.65	-0.01	-0.82
3	2.72	0.67	3.07	1.07	3.75	1.50	-0.98	-2.50**
4	2.96	1.10	2.87	0.98	3.27	0.72	0.20	-0.88
5	2.58	0.87	3.07	1.03	2.90	0.76	-1.24	-1.06
6	2.31	0.66	2.50	0.81	2.63	0.86	-0.64	-1.16
7	2.69	0.98	2.79	0.77	2.96	0.97	-0.24	-0.70
8	2.78	0.70	2.93	0.57	3.49	1.62	-0.53	-1.63
9	2.72	0.71	2.78	0.52	3.81	1.98	-0.18	-1.98*
10	2.97	1.81	3.05	1.09	3.33	1.20	-0.11	-0.61
11	2.15	0.90	2.51	0.99	4.01	2.47	-0.91	-2.83**
12	2.87	1.73	2.78	0.47	3.04	1.02	0.14	-0.30

*p less than .05
**p less than .01

APPENDIX TABLE V

MEANS, STANDARD DEVIATIONS, AND *t*-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE SOCIAL SOUNDS TEST (AUDITORY-AUDITORY)

Test Item	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	6.43	1.74	5.54	0.37	6.58	1.54	1.27	-0.23
2	5.10	0.87	4.77	0.58	5.45	1.97	0.99	-0.62
3	5.10	1.34	4.85	0.88	6.21	2.00	0.46	-1.75*
4	4.40	0.69	4.19	0.28	5.09	1.02	0.85	-2.23*
5	4.33	1.06	4.34	0.59	5.49	2.06	-0.03	-2.04*
6	4.00	0.94	4.19	1.53	4.94	1.01	-0.38	-2.60**
7	4.16	1.11	4.27	0.88	4.75	0.94	-0.24	-1.51
8	5.17	1.45	4.67	0.28	5.30	0.91	0.86	-0.27
9	4.20	1.27	3.96	0.50	4.70	1.58	0.47	-0.92
10	4.73	0.81	5.46	2.09	5.19	1.51	-1.24	-1.05
11	3.86	0.97	4.49	1.89	4.87	1.92	-1.05	-1.88*
12	4.38	0.97	3.69	0.72	5.14	1.48	1.71*	-1.67

*p less than .05
**p less than .01

APPENDIX TABLE VI

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE NONSENSE SYLLABLES TEST (AUDITORY-AUDITORY)

Test Item	Control Group (N=19)		Learning Disability Groups: School (N=10)		Learning Disability Groups: Clinic (N=14)		t-Scores: Control vs. School	t-Scores: Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	4.57	0.84	5.32	1.59	5.57	0.82	-1.52	-3.22**
2	4.67	0.90	4.50	0.70	4.77	0.52	0.47	-0.35
3	5.23	0.76	4.94	0.49	5.53	0.62	0.99	-1.14
4	4.58	0.83	4.69	0.70	4.75	0.79	-0.31	-0.57
5	5.13	0.70	5.05	0.42	5.40	1.11	0.33	-0.80
6	4.55	0.95	4.13	0.33	4.87	0.73	1.21	-1.01
7	6.54	2.27	4.68	0.63	6.52	1.85	2.16*	0.01
8	5.28	0.97	4.80	0.44	5.20	0.90	1.36	0.23
9	4.72	0.64	4.77	0.66	4.99	0.74	-0.16	-1.04
10	4.75	1.01	4.69	0.55	4.98	1.01	0.15	-0.61
11	5.20	0.87	5.44	0.49	6.01	1.32	-0.77	-2.06*
12	4.83	0.62	4.84	0.53	5.58	1.51	-0.05	-1.87*

*p less than .05
**p less than .01

APPENDIX TABLE VII

MEANS, STANDARD DEVIATIONS, AND *t*-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE WORDS TEST (AUDITORY-AUDITORY)

Test Item	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Control vs. School	Control vs. Clinic
1	5.45	0.82	5.57	0.62	5.77	2.07	-0.35	-0.54
2	4.67	0.86	4.19	0.50	4.52	0.68	1.50	0.51
3	5.15	0.58	5.26	0.97	5.49	0.59	-0.33	-1.56
4	4.65	0.32	4.66	0.71	4.85	0.62	-0.02	-1.11
5	4.96	1.16	4.28	0.51	4.96	0.74	1.69	0.00
6	4.59	1.18	4.18	0.59	4.82	1.37	0.96	-0.48
7	4.81	0.83	4.54	0.59	4.86	0.71	0.88	-0.18
8	5.27	0.63	5.09	0.85	5.81	1.30	0.60	-1.52
9	5.18	0.99	5.01	0.80	5.52	1.07	0.42	-0.88
10	4.59	0.51	4.44	0.78	4.95	0.62	0.58	-1.68
11	3.72	0.54	3.63	0.55	3.86	0.64	0.41	-0.64
12	5.38	1.13	5.00	0.73	5.33	0.83	0.86	0.12

APPENDIX TABLE VIII

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE GEOMETRIC DESIGNS TEST (VISUAL-VISUAL)

Test Item	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	4.40	1.56	4.06	1.68	3.85	0.82	0.51	1.09
2	3.39	1.32	3.00	0.63	3.13	0.54	0.81	0.64
3	2.51	0.47	2.55	0.23	2.91	0.81	-0.24	-1.71*
4	3.17	1.48	2.51	0.65	3.99	1.59	1.29	-1.47
5	2.99	0.70	2.42	0.66	3.24	0.64	2.05*	-1.00
6	2.52	0.49	2.96	1.56	3.03	0.87	-1.08	-2.06*
7	2.92	1.02	2.78	0.56	3.17	0.35	0.39	-0.85
8	2.53	0.67	3.79	0.60	3.62	1.00	-0.98	-3.60**
9	2.36	1.20	2.21	0.41	3.15	1.18	0.36	-1.83*
10	2.96	1.28	2.48	0.61	2.73	0.60	1.09	0.59
11	2.07	0.48	2.53	1.03	2.74	0.77	-1.58	-2.96**
12	2.42	0.44	2.58	0.76	3.01	0.79	-0.69	-2.66**

*p less than .05
**p less than.01

APPENDIX TABLE IX

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE PICTURES TEST (VISUAL-VISUAL)

Test Item	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	2.75	0.70	2.81	0.49	3.51	1.64	-0.24	-1.75*
2	2.31	0.39	2.44	0.42	3.06	0.61	-0.82	-4.16**
3	2.25	0.38	2.17	0.40	2.91	0.68	0.49	-3.45**
4	2.15	0.54	2.53	0.68	3.11	1.00	-1.57	-3.40**
5	2.14	0.75	2.08	0.43	2.88	1.43	0.21	-1.87*
6	1.93	0.53	2.31	0.88	2.74	0.82	-1.38	-3.33**
7	3.43	1.73	2.65	0.74	2.99	0.82	1.31	0.85
8	2.21	0.89	2.32	1.14	2.48	1.24	-0.27	-0.70
9	2.36	0.70	2.26	0.52	2.76	0.96	0.36	-1.35
10	2.52	0.70	2.54	0.45	3.04	0.43	-0.09	-2.38*
11	2.67	1.44	2.42	0.30	2.87	0.61	0.51	-0.48
12	2.45	1.09	2.02	0.44	2.81	1.25	1.08	-0.86

*p less than .05
**p less than .01

APPENDIX TABLE X

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE NONSENSE SYLLABLES TEST (VISUAL-VISUAL)

Test Item	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	2.67	0.48	2.54	0.70	3.59	1.72	0.56	-2.13*
2	2.98	0.57	2.57	0.62	4.40	1.56	1.68	-3.46**
3	2.44	0.48	2.28	0.53	3.53	1.34	0.79	-3.16**
4	4.09	1.66	3.83	1.30	3.77	0.71	0.41	0.61
5	3.02	1.05	2.40	1.02	3.83	1.62	1.47	-1.66
6	4.07	1.72	3.22	1.16	4.45	1.70	1.35	-0.59
7	4.64	1.99	3.27	1.78	4.36	1.57	1.74*	0.42
8	4.52	1.94	4.42	1.62	4.32	1.25	0.12	0.30
9	4.94	1.73	3.22	0.94	4.46	1.81	2.82**	0.73
10	4.80	1.91	4.93	2.01	5.20	1.93	-0.16	-0.58
11	4.68	1.56	4.03	1.65	4.42	1.76	0.96	0.43
12	4.60	1.95	3.87	1.42	4.82	1.78	1.00	-0.30

*p less than .05
**p less than .01

APPENDIX TABLE XI

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE WORDS TEST (VISUAL-VISUAL)

	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)			
Test Item	Mean	S.D.	Mean	S.D.	Mean	S.D.	Control vs. School	Control vs. Clinic
1	3.08	0.66	2.50	0.35	4.17	1.38	2.47**	-2.93**
2	2.25	0.48	2.10	0.42	3.35	1.19	0.79	-3.53**
3	3.01	1.43	2.38	0.67	3.48	0.96	1.26	-1.00
4	2.96	1.37	2.47	0.80	4.09	1.02	0.99	-2.46**
5	3.24	1.63	2.04	1.12	4.92	1.60	0.50	-2.78**
6	2.49	1.30	2.27	0.96	3.08	1.49	0.46	-1.14
7	3.11	0.86	2.54	0.78	4.22	1.96	1.69	-2.11*
8	2.94	0.86	3.02	1.10	3.51	1.13	-0.20	-1.55
9	2.98	1.61	2.71	0.61	4.78	1.48	0.50	-3.17**
10	2.94	0.77	2.80	1.57	4.35	1.70	0.30	-3.10**
11	3.68	1.22	3.38	1.25	4.26	1.11	0.60	-1.35
12	3.73	2.05	2.38	0.92	5.34	2.25	1.90*	-2.04*

*p less than .05
**p less than .01

APPENDIX TABLE XII

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE SOCIAL TEST (AUDITORY-VISUAL)

Test Item	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	5.37	1.94	4.51	1.78	4.74	2.43	1.06	0.71
2	2.86	0.76	3.08	0.47	3.39	1.13	-0.71	-1.49
3	3.05	1.23	2.41	0.67	3.19	0.98	1.32	-0.31
4	2.94	0.91	2.60	0.46	3.59	1.56	0.95	-1.36
5	2.89	1.15	3.08	1.19	2.83	0.84	-0.35	0.16
6	2.41	1.30	2.13	2.13	2.02	0.74	0.39	0.90
7	3.34	1.76	3.08	1.92	3.44	1.36	0.32	-0.16
8	2.74	0.81	2.08	0.55	3.09	1.08	2.01*	-0.98
9	2.69	0.83	2.80	1.92	3.08	1.17	-0.18	-1.01
10	3.26	1.73	2.94	0.98	3.14	1.22	0.47	0.20
11	3.21	1.05	2.81	1.03	3.37	1.42	0.83	-0.35
12	3.52	1.17	2.86	0.97	3.61	1.29	1.30	-0.18

*p less than .05

APPENDIX TABLE XIII

MEANS, STANDARD DEVIATIONS, AND $\underline{t}$-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE WORDS TEST (AUDITORY-VISUAL)

Test Item	Control Group (N=19) Mean	Control Group (N=19) S.D.	Learning Disability Groups: School (N=10) Mean	Learning Disability Groups: School (N=10) S.D.	Learning Disability Groups: Clinic (N=14) Mean	Learning Disability Groups: Clinic (N=14) S.D.	t-Scores: Control vs. School	t-Scores: Control vs. Clinic
1	2.93	1.00	2.65	0.93	3.50	1.05	0.67	-1.48
2	2.40	0.66	2.26	0.69	3.01	1.23	0.49	-1.66
3	2.93	1.38	2.71	1.20	3.38	1.27	0.40	-0.87
4	2.43	0.87	2.67	1.16	3.28	1.38	-0.57	-1.96*
5	2.13	0.84	1.98	0.48	2.85	1.21	0.49	-1.88*
6	1.75	0.76	2.21	0.84	3.01	1.50	-1.41	-2.92**
7	2.37	1.56	2.42	0.86	2.66	0.79	-0.09	-0.63
8	2.36	1.10	2.77	0.76	3.07	1.01	-1.00	-1.80*
9	2.09	0.62	2.56	1.24	3.22	1.22	-1.25	-3.18**
10	2.01	0.77	2.57	1.27	3.49	1.74	-1.37	-3.03**
11	2.75	1.54	3.16	1.83	3.35	1.71	-0.59	-0.97
12	2.20	0.92	2.90	1.76	2.60	0.79	-1.25	-1.19

*$\underline{p}$ less than .05
**$\underline{p}$ less than .01

APPENDIX TABLE XIV

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE SOCIAL TEST (VISUAL-AUDITORY)

Test Item	Control Group (N=19)		Learning Disability Groups				t-Scores	
			School (N=10)		Clinic (N=14)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	5.29	1.28	4.17	1.27	6.60	2.42	1.89*	-1.85*
2	3.97	0.99	3.74	0.55	4.93	1.35	0.53	-2.18*
3	6.84	2.50	5.73	1.03	6.59	1.32	1.17	0.33
4	6.01	1.31	5.40	1.29	6.44	2.31	1.10	-0.64
5	5.14	2.16	4.81	0.99	5.51	2.07	0.41	-0.45
6	5.46	1.11	5.25	1.38	6.35	1.58	0.37	-1.74*
7	5.47	1.23	5.13	0.41	5.56	0.70	0.73	-0.25
8	4.83	0.82	4.91	0.83	5.13	1.50	-0.22	-0.69
9	4.95	1.40	4.07	1.30	6.04	1.55	1.36	-2.00*
10	5.08	1.94	4.71	0.82	5.32	1.29	0.48	-0.39
11	5.70	2.11	5.54	1.04	6.55	2.00	0.19	-1.05
12	5.26	1.37	4.56	0.70	5.75	1.24	1.37	-0.97

*p less than .05

APPENDIX TABLE XV

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF EIGHT-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE WORDS TEST (VISUAL-AUDITORY)

	Control Group		Learning Disability Groups				t-Scores	
	(N=19)		School (N=10)		Clinic (N=14)		Control vs. School	Control vs. Clinic
Test Item	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	5.61	0.72	6.43	1.66	7.41	2.07	-1.68	-3.24**
2	5.18	0.59	5.40	0.50	6.60	2.12	-0.90	-2.61**
3	4.23	0.32	4.29	0.87	5.05	0.73	-0.21	-3.82**
4	5.16	0.77	5.19	0.47	6.38	1.34	-0.09	-2.63**
5	5.59	1.54	5.02	0.71	5.44	0.87	1.00	0.30
6	5.68	1.15	5.74	1.41	5.83	1.57	-0.11	-0.29
7	5.24	1.07	5.59	0.79	6.66	1.60	-0.81	-2.69**
8	5.72	1.48	5.90	1.54	5.77	1.30	-0.27	-0.09
9	5.92	1.74	5.84	1.04	6.38	1.82	0.11	-0.68
10	5.06	0.90	5.60	1.43	6.33	1.93	-1.11	-2.28*
11	5.97	1.72	5.30	0.76	5.75	1.05	1.01	0.38
12	5.08	1.14	4.80	0.72	5.53	1.19	0.60	-1.04

*p less than .05
**p less than .01

APPENDIX TABLE XVI

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE FREQUENCY PATTERNS TEST (AUDITORY-AUDITORY)

Test Item	Control Group (N=49)		Learning Disability Groups School (N=21)		Learning Disability Groups Clinic (N=17)		t-Scores	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Control vs. School	Control vs. Clinic
1	2.68	1.81	2.72	1.88	3.09	1.80	-0.09	-0.76
2	2.24	1.58	2.16	1.45	1.91	0.83	0.18	0.77
3	1.59	0.84	1.93	1.70	1.71	1.17	-1.10	-0.47
4	1.62	0.58	1.63	0.84	1.64	0.61	-0.02	-0.09
5	2.03	0.94	1.83	0.70	2.12	0.87	0.88	-0.32
6	1.79	0.58	1.98	0.70	2.32	1.14	-1.11	-2.39**
7	1.69	0.66	1.59	0.47	2.14	0.94	0.59	-2.12*
8	1.78	0.87	1.50	0.36	2.11	1.21	1.40	-1.20
9	1.51	0.53	1.55	0.40	1.61	0.60	-0.31	-0.61
10	1.58	0.58	1.50	0.44	1.86	0.87	0.56	-1.43
11	1.56	0.72	1.38	0.34	1.69	0.70	1.05	-0.64
12	1.80	0.87	1.53	0.42	2.03	1.58	1.31	-0.73

*p less than .05
**p less than .01

APPENDIX TABLE XVII

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE DURATION PATTERNS TEST (AUDITORY-AUDITORY)

Test Item	Control Group (N=49)		Learning Disability Groups: School (N=21)		Learning Disability Groups: Clinic (N=17)		t-Scores: Control vs. School	t-Scores: Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	3.17	1.03	3.26	1.66	2.92	0.66	-0.27	0.92
2	2.83	0.98	3.13	1.99	2.93	1.25	-0.79	-0.33
3	2.88	0.95	3.01	0.82	3.01	1.10	-0.54	-0.45
4	2.79	1.48	2.93	1.03	3.60	1.92	-0.36	-1.65
5	2.30	0.68	2.41	0.89	2.41	0.82	-0.52	-0.53
6	2.13	0.89	2.30	1.22	2.73	1.92	-0.60	-1.65
7	2.85	1.13	2.93	1.32	3.21	0.99	-0.21	-0.53
8	2.91	1.41	2.83	0.87	3.19	1.28	0.23	-0.65
9	3.03	1.12	2.98	1.30	3.29	1.35	0.13	-0.67
10	2.83	0.59	3.51	1.63	3.08	1.09	-2.13*	-0.84
11	2.37	0.88	2.17	0.90	3.33	2.02	0.79	-2.58**
12	2.57	1.05	2.54	0.62	2.78	0.89	0.11	-0.69

*p less than .05
**p less than.01

APPENDIX TABLE XVIII

MEANS, STANDARD DEVIATIONS, AND *t*-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE SOCIAL SOUNDS TEST (AUDITORY-AUDITORY)

Test Item	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	6.20	0.78	5.89	0.93	6.35	1.95	1.31	-0.41
2	5.23	0.78	4.91	0.99	5.26	1.50	1.39	-0.12
3	5.39	0.73	4.96	0.91	5.43	1.33	1.97*	-0.13
4	4.52	1.35	3.95	0.49	3.94	1.05	1.82*	1.46
5	4.56	0.64	4.05	0.92	4.95	0.98	2.59**	-1.79*
6	4.24	0.61	3.65	1.09	4.73	2.16	2.71**	-1.36
7	4.65	0.68	4.23	1.04	4.37	0.90	1.93*	1.29
8	4.91	0.65	4.38	0.75	5.07	1.13	2.80**	-0.69
9	4.15	0.82	3.72	0.96	4.14	0.56	1.72*	0.05
10	4.72	0.74	4.79	0.83	5.06	0.68	-0.31	-1.56
11	3.88	0.89	3.82	0.82	3.84	0.40	0.28	0.18
12	4.39	0.68	4.30	0.98	4.20	0.82	0.41	0.86

*p less than .05
**p less than .01

APPENDIX TABLE XIX

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE NONSENSE SYLLABLES TEST (AUDITORY-AUDITORY)

	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)		Control vs. School	Control vs. Clinic
Test Item	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	5.11	1.70	4.41	0.60	5.64	2.59	1.72*	-0.87
2	4.60	0.83	4.47	0.68	5.79	2.11	0.60	-3.16**
3	5.22	1.16	5.04	1.39	5.47	1.17	0.50	-0.72
4	4.37	0.67	4.62	1.32	4.91	1.80	-1.01	-1.75*
5	5.11	0.76	4.94	0.69	5.59	1.73	0.79	-1.75*
6	4.42	0.56	4.40	0.55	4.63	1.22	0.14	-0.92
7	5.23	0.99	5.51	1.45	6.00	2.02	-0.86	-2.00*
8	4.72	0.53	4.67	0.71	4.89	0.58	0.30	-1.14
9	4.70	0.60	4.76	1.21	5.15	1.67	-0.26	-1.59
10	4.57	0.55	4.45	0.93	4.84	0.69	0.61	-1.56
11	5.16	0.71	4.84	0.71	5.47	0.95	1.68*	-1.36
12	5.08	0.92	4.44	0.56	5.00	0.90	2.88**	0.29

*p less than .05
**p less than .01

APPENDIX TABLE XX

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE WORDS TEST (AUDITORY-AUDITORY)

Test Item	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	5.59	1.50	5.06	0.66	5.55	1.69	1.45	0.09
2	4.51	1.18	4.54	0.70	4.40	0.73	-0.07	0.35
3	5.28	0.98	4.98	0.66	5.91	1.63	1.18	-1.86*
4	4.62	0.60	4.44	0.58	5.48	1.78	1.11	-2.89**
5	4.81	0.85	4.76	0.98	4.59	0.59	0.21	0.98
6	4.36	0.57	4.45	0.96	4.55	0.78	-0.45	-0.97
7	4.61	0.63	4.67	0.83	4.68	0.61	-0.30	-0.40
8	5.36	0.80	5.22	0.47	5.26	0.76	0.76	0.46
9	5.09	0.98	4.78	0.69	5.12	1.02	1.26	-0.10
10	4.72	0.69	4.60	0.75	4.99	1.10	0.62	-1.15
11	3.83	0.67	3.66	0.45	3.91	0.52	1.00	-1.44
12	5.31	1.30	5.13	0.68	5.40	0.89	0.54	-0.26

*p less than .05
**p less than .01

APPENDIX TABLE XXI

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE GEOMETRIC DESIGNS TEST (VISUAL-VISUAL)

	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)			
Test Item	Mean	S.D.	Mean	S.D.	Mean	S.D.	Control vs. School	Control vs. Clinic
1	4.07	1.32	3.38	0.57	3.56	0.77	2.27*	1.46
2	2.94	0.83	2.93	1.25	2.91	0.55	0.03	0.14
3	2.38	0.47	2.28	0.45	2.79	0.86	0.80	-2.43**
4	2.89	1.35	2.74	0.82	3.45	1.59	0.46	-1.38
5	2.70	0.58	2.64	0.61	3.23	0.92	0.38	-2.64**
6	2.59	0.67	2.71	1.17	2.56	0.47	-0.51	0.18
7	2.98	1.21	2.57	0.63	2.88	0.94	1.44	0.28
8	2.52	0.88	2.67	1.21	3.29	0.96	-0.57	-2.98**
9	2.10	0.61	2.13	0.57	2.89	1.10	-0.22	-3.63**
10	2.65	0.77	2.54	0.76	2.60	0.43	0.50	0.23
11	2.14	0.70	2.36	0.67	2.75	1.29	-1.21	-2.40**
12	2.54	0.70	2.21	0.43	2.86	1.39	1.99*	-1.19

*p less than .05
**p less than .01

APPENDIX TABLE XXII

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE PICTURES TEST (VISUAL-VISUAL)

Test Item	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Control vs. School	Control vs. Clinic
1	2.49	0.43	2.53	0.61	2.59	0.73	-0.35	-0.67
2	2.36	0.48	2.27	0.39	2.51	0.63	0.76	-0.99
3	2.28	0.61	2.14	0.57	2.45	0.56	0.87	-0.98
4	2.21	0.72	2.29	0.59	2.38	1.07	-0.45	-0.71
5	1.89	0.65	1.99	0.73	2.06	0.47	-0.57	-0.98
6	2.00	0.65	2.20	1.03	2.43	1.44	-0.93	-1.63
7	2.96	1.36	2.53	0.93	3.38	1.61	1.29	-1.00
8	2.04	0.48	1.78	0.51	2.44	1.52	1.97*	-1.58
9	2.34	0.92	2.34	0.80	2.53	0.71	0.00	-0.74
10	2.43	0.57	2.43	0.69	2.39	0.62	-0.01	0.19
11	2.38	0.56	2.21	0.48	2.43	0.62	1.19	-0.33
12	2.12	0.64	2.41	1.14	2.29	1.17	-1.30	-0.72

*p less than .05

APPENDIX TABLE XXIII

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE NONSENSE SYLLABLES TEST (VISUAL-VISUAL)

Test Item	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Control vs. School	Control vs. Clinic
1	2.29	0.63	2.48	4.79	2.55	0.69	-1.04	-1.38
2	2.57	0.56	2.51	0.55	2.99	0.62	0.39	-2.54**
3	2.23	1.12	2.19	0.83	3.44	2.02	0.15	-3.00**
4	3.42	1.33	3.01	1.25	4.31	1.86	1.18	-2.05*
5	2.76	0.89	3.02	1.32	3.76	1.42	-0.95	-3.26**
6	3.60	1.60	3.60	1.42	4.12	1.58	-0.00	-1.15
7	4.16	1.87	4.40	1.76	4.23	1.53	-0.47	-0.11
8	4.26	2.00	4.36	1.74	4.11	1.80	-0.18	0.26
9	4.33	2.08	4.02	1.53	4.01	1.72	0.61	0.54
10	4.23	1.81	3.54	2.06	4.26	2.00	1.38	-0.05
11	4.38	1.74	3.82	1.84	4.44	1.95	1.19	-0.11
12	4.17	1.60	4.35	1.71	4.33	1.79	-0.39	-0.31

*p less than .05
**p less than .01

APPENDIX TABLE XXIV

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE WORDS TEST (VISUAL-VISUAL)

	Control Group		Learning Disability Groups				t-Scores	
	(N=49)		School (N=21)		Clinic (N=17)		Control vs. School	Control vs. Clinic
Test Item	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	2.60	0.50	2.67	0.52	3.04	1.11	-0.47	-2.16*
2	2.19	0.60	2.17	0.52	2.56	0.77	0.14	-1.91*
3	2.29	0.48	2.49	0.76	3.01	1.08	-1.31	-3.60**
4	2.43	0.73	2.67	1.35	3.57	1.44	-0.93	-4.09**
5	2.76	0.78	3.09	1.72	4.11	1.74	-1.09	-4.21**
6	2.04	0.73	2.15	0.84	2.75	1.08	-0.51	-2.96**
7	2.63	0.73	2.54	0.72	3.31	1.03	0.49	-2.88**
8	2.80	1.06	2.71	1.05	3.64	1.38	0.34	-2.49**
9	2.78	1.36	3.07	1.54	2.96	1.20	-0.77	-0.43
10	2.66	0.98	2.54	0.80	3.60	1.04	0.47	-3.22**
11	3.14	1.35	3.40	1.31	4.27	1.45	-0.73	-2.76**
12	3.51	1.61	3.80	1.71	4.30	1.98	-0.67	-1.55

*p less than .05
**p less than .01

APPENDIX TABLE XXV

MEANS, STANDARD DEVIATIONS, AND *t*-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE SOCIAL TEST (AUDITORY-VISUAL)

Test Item	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	4.35	1.63	4.55	2.10	4.57	2.15	-0.40	-0.39
2	3.00	1.17	3.30	1.34	3.70	1.42	-0.88	-1.91*
3	2.70	0.97	2.36	0.66	3.09	1.03	1.36	-1.33
4	2.73	1.14	2.41	0.78	2.89	0.97	1.10	-0.50
5	2.26	0.87	2.24	0.80	2.41	1.47	0.09	-0.46
6	2.27	1.36	2.13	0.77	2.13	0.87	0.42	0.35
7	2.78	1.14	2.63	1.08	3.57	1.35	0.47	-2.29*
8	2.44	0.88	2.75	1.72	2.65	0.80	-0.95	-0.88
9	2.42	1.05	2.73	1.26	2.41	1.60	-0.99	0.02
10	2.56	0.96	2.34	1.27	2.31	0.77	0.73	0.93
11	3.02	1.40	2.91	1.43	3.17	1.48	0.28	-0.35
12	2.94	1.37	3.21	2.10	3.43	1.44	-0.59	-1.19

*p less than .05

APPENDIX TABLE XXVI

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE WORDS TEST (AUDITORY-VISUAL)

	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)		Control vs. School	Control vs. Clinic
Test Item	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	2.63	1.01	2.98	1.67	3.08	1.05	-1.02	-1.54
2	2.21	0.98	1.92	0.49	2.66	1.11	1.19	-1.52
3	2.35	1.08	2.21	0.74	2.64	1.20	0.49	-0.90
4	2.27	0.97	2.31	1.18	2.91	1.32	-0.12	-2.07*
5	1.91	0.63	1.88	0.79	1.99	0.73	0.18	-0.43
6	1.67	0.59	1.96	1.04	1.94	0.92	-1.34	-1.33
7	1.87	0.83	1.84	0.60	2.89	1.46	0.13	-3.41**
8	2.03	0.71	2.49	1.07	2.75	1.05	-1.97*	-3.08**
9	1.97	0.69	1.89	0.85	2.46	0.72	0.39	-2.45**
10	1.77	0.61	2.15	0.75	2.44	0.97	-2.07*	-3.16**
11	2.27	1.04	2.50	1.20	3.25	1.44	-0.74	-2.94**
12	2.27	1.13	2.24	0.99	2.31	0.72	0.10	-0.13

*p less than .05
**p less than .01

APPENDIX TABLE XXVII

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE SOCIAL TEST (VISUAL-AUDITORY)

Test Item	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)			
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Control vs. School	Control vs. Clinic
1	5.11	1.35	4.18	1.10	5.13	2.61	2.59**	-0.04
2	3.74	0.89	3.80	1.35	3.93	1.29	-0.19	-0.64
3	6.45	1.70	6.01	1.57	5.92	1.64	0.95	1.08
4	6.52	1.24	6.01	1.16	5.85	1.68	1.59	1.69*
5	4.64	0.82	4.48	1.67	5.14	1.47	0.50	-1.69*
6	5.80	1.27	5.30	1.16	5.26	1.61	1.40	1.31
7	5.39	1.23	5.06	1.19	5.28	1.60	0.98	0.30
8	4.86	1.24	4.54	0.98	4.71	1.47	0.94	0.37
9	5.24	1.72	4.66	1.54	4.68	1.32	1.17	1.18
10	4.70	0.97	4.74	1.10	4.32	1.12	-0.13	1.30
11	5.75	1.23	5.90	1.98	5.11	1.19	-0.35	1.73*
12	5.42	1.55	4.75	1.31	5.07	1.04	1.56	0.84

*p less than .05
**p less than .01

APPENDIX TABLE XXVIII

MEANS, STANDARD DEVIATIONS, AND t-SCORES FOR RESPONSE TIMES OF NINE-YEAR-OLD CHILDREN ON THE INDIVIDUAL ITEMS FROM THE WORDS TEST (VISUAL-AUDITORY)

Test Item	Control Group (N=49)		Learning Disability Groups				t-Scores	
			School (N=21)		Clinic (N=17)		Control vs. School	Control vs. Clinic
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
1	5.48	0.75	5.46	0.65	6.03	1.41	0.13	-1.92*
2	5.01	0.93	4.89	0.78	5.45	1.57	0.53	-1.34
3	4.31	0.44	4.62	1.10	4.97	1.65	-1.54	-2.39**
4	5.75	1.21	5.48	1.33	6.71	2.01	0.79	-2.22*
5	4.99	1.19	4.86	0.49	6.03	2.12	0.48	-2.39**
6	5.44	1.32	5.46	1.40	5.94	1.77	-0.04	-1.15
7	5.75	1.31	5.42	0.73	6.11	1.34	1.03	-0.92
8	5.30	1.43	5.05	0.78	5.43	0.64	0.72	-0.33
9	5.42	1.20	5.31	0.89	6.15	1.22	0.36	-2.08*
10	5.19	1.29	4.74	0.73	6.31	1.33	1.32	-2.98**
11	5.43	1.19	5.49	1.08	5.86	1.09	-0.18	-1.26
12	4.71	0.89	4.73	1.10	4.95	0.49	-0.05	-1.03

*p less than .05
**p less than .01

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TYPE OF RELEASE

15. ABSTRACT *(250 words max.)*

This study was intended to describe and compare the psychosensory functioning of normal children and children with specific learning disabilities. A total of 130 children were studied. Some of the learning disability children were selected by means of a screening and intensive psychoeducational diagnostic process from the public schools. Others were children referred to a special clinic for diagnosis of learning disabilities. Each of these children was given a battery of thirteen subtests on an automated psychosensory system. The thirteen subtests represented various combinations of auditory and visual intra- and intersensory conditions for verbal, nonverbal-nonsocial, and nonverbal-social stimuli. Comparisons were made between the normal children and the two types of learning disability groups (a school learning disability group and a clinic learning disability group). Two age groups of children were considered: eight year olds and nine year olds. Errors and response times were the primary measures utilized in the analysis.

The clinic learning disabilities appeared to have more acute disorders as a group than the school-derived population of learning disabilities. They made significantly more errors on verbal psychosensory functions, regardless of the sensory conditions. In addition, the nine-year-old group displayed significant problems of an auditory intrasensory nature. There was a generalized failure of the clinic learning disabilities to perform the tasks with speed equivalent to their comparison groups. The use of response time criteria, a feature unique to the Psychosensory Communications System, seemed encouraging as an area for future investigation. Further refinement and sensitization of response time measures for psychosensory evaluations would be useful.

16. RETRIEVAL TERMS *(Continue on reverse)*

17. IDENTIFIERS

Figure 3. ERIC Document Resume